STATE EMERGENCY MANAGEMENT AGENCY

MISSOURI HAZARD ANALYSIS

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Prepared by:

STATE EMERGENCY MANAGEMENT AGENCY
STATE OF MISSOURI
P.O. BOX 116
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October 2006

Matt Blunt
Governor

STATE OF MISSOURI

EMERGENCY MANAGEMENT AGENCY

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Ronald Reynolds
Director

M E M O R A N D U M

To: ALL STATE-WIDE HAZARD ANALYSIS HOLDERS

From: Ronald M. Reynolds, DIRECTOR OF SEMA

This revised Missouri State-wide Hazard Analysis is the result of the collective efforts of all the branches of SEMA. This analysis assesses various risks facing the state and its communities so that the risks can be evaluated and ranked. This process is then used to characterize hazards for emergency planning. It estimates the probability of occurrence and the severity of consequences for each hazard and provides a method of comparison.

We are pleased to present the FY '06 revisions to the State Hazard Analysis in loose-leaf format to insert in your copy of the plan. Each year, we will forward those annexes that have been revised or updated when they are completed by our staff.

State agencies and local jurisdictions should use this hazard analysis for planning, prioritization, and resource allocation. The information contained herein should identify capabilities essential to disaster response; for determining the probable effectiveness of allocating resources in emergency situations; and for encouraging the cooperation of various political subdivisions and emergency services in formulating regulations, plans and programs in order to mitigate disasters and minimize loss of life, human suffering, and damage to public and private property.

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PURPOSE

The emergency management community now faces threats in many ways different than past threats. Gone are the days when emergency management was only for natural disasters and nuclear preparedness. We now face more technologically and politically based hazards that demand the attention of the emergency management community. These new hazards include a number of threats that have not been adequately dealt with in the past, including hazardous materials releases, civil disorders, and terrorism.

This document has been compiled to identify the multiplicity of hazards that exist at varying locations and degrees of magnitude throughout the state and to determine the potential impacts of these hazards on residents, property, and the environment. The information contained herein identifies capabilities essential to disaster response, for determining the probable effectiveness of allocating resources in emergency situations, and for encouraging the cooperation of various political subdivisions and emergency services in formulating regulations, plans, and programs to prepare for disasters and minimize loss of life, human suffering, and damage to public and private property. In addition, a thorough hazard analysis provides a foundation for educating senior government officials and the public on dangers posed by various hazards.

This Hazard Analysis assesses various risks facing the state and its communities in order to evaluate and rank them. This process is then used to characterize hazards for emergency planning. It estimates the probability of occurrence and the severity of consequences for each hazard and provides a method of comparison. The evaluation involves many interrelated variables (toxicity, demographics, topography, etc.), and should be used by state and local officials in planning and prioritizing allocation of resources.

The hazards presented here are those that have been experienced by, or pose a potential threat to, Missourians. However, local or isolated problems that constitute potential disasters should not be overlooked.

The following definitions explain the ratings for each hazard:

Probability: The likelihood that the hazard will occur.

Low	The hazard has little or no chance of happening.
Moderate	The hazard has a reasonable probability of occurring.
High	The probability is considered sufficiently high to assume that the event will occur.

Severity: The deaths, injuries, or damages (property or environmental) that could result from the hazard.

Low	Few or minor damages or injuries are likely.
Moderate	Injuries to personnel and damages to property and the environment is expected.
High	Deaths and major injuries and damages will likely occur.

The hazards covered in the analysis are listed below, along with the overall rating they were given. The ratings presented below are situational dependent.

Tornadoes/Severe Thunderstorms
Probability: High
Severity: High

Dam Failures
Probability: Low
Severity: Moderate

Heat Wave
Probability: Moderate
Severity: Moderate

Severe Winter Weather/Snow/Ice/Severe Cold
Probability: High (North of Missouri River)
Probability: Low (South of Missouri River)
Severity: Moderate (North of Missouri River)
Severity: Moderate (South of Missouri River)

Attack
(Nuclear/Conventional/Chemical/Biological)
Probability: Low
Severity: High

Utilities (Interruptions and System Failures)
Probability: High
Severity: Low

Public Health Emergencies/Environmental Issues
Probability: High
Severity: Moderate to High

Nuclear Power Plants (Emergencies/Accidents)
Probability: Moderate
Severity: Moderate

Floods (Major and Flash)
Probability: High
Severity: High

Special Events
Probability: Low
Severity: Low to High

Drought
Probability: Moderate
Severity: Moderate

Earthquakes
Probability: High
Severity: High

Fires
(Structural & Urban)
Probability: High
Severity: Moderate

(Wild)
Probability: Moderate
Severity: Low to Moderate

Terrorism
Probability: Low
Severity: Low to High

Mass Transportation Accidents
Probability: Moderate
Severity: Moderate

Hazardous Materials
(Fixed Facility Accidents)
Probability: Moderate
Severity: Moderate

(Transportation Accidents)
Probability: High
Severity: Moderate

Civil Disorder
Probability: Low
Severity: Low to High

INTRODUCTION

Because Missouri is located in the middle section of the United States, it is prone to several kinds of natural hazards. Missouri has a continental climate; in other words, the weather is changeable and has large variations in temperature and precipitation.

Missouri serves as a major thoroughfare for transportation and has an abundant share of industrial, agricultural, and recreational facilities. Thus, man-made disasters can occur, such as hazardous materials releases, fixed nuclear facility incidents, and other emergencies caused by human action.

Missouri has four topographically distinct regions: glaciated plains in the north, plains or prairie in the west, lowlands in the extreme southeast, and the Missouri Ozarks in between.

The plains section, both glaciated and unglaciated, encompasses nearly all the area north of the Missouri River and a large area south of the river in the western part of the state. The topography varies from rolling hills in the east to hills in the west that average about 450 feet above sea level. There are numerous wide, flat valleys cut by the river.

The Ozarks, which comprise about half of the state, are characterized by rugged areas of sharp ridges and deep narrow valleys. Elevations range from about 1,000 to more than 1,600 feet above sea level.

The southeastern lowlands cover about 3,000 square miles, with elevations from 230 to 300 feet above sea level. Much of the region is excellent farmland, channeled by an extensive system of drainage ditches.

Because the state is situated along two of the continent's greatest rivers, the Missouri and the Mississippi Rivers, the potential for great floods is high. While six large flood control dams have been built on the mainstream of the Missouri River, they have not eliminated the flood threat.

Warm and cool air masses often collide along sharply divided "fronts," accompanied by violent thunderstorms having intense rains, strong winds, hail, and occasional tornadoes. These frontal storm systems can pass across the state at any time of the year, but are most frequent during the spring months (March, April and May). There are two important truths about Missouri's weather: (1) the state is subject to weather extremes, and (2) extreme weather changes can occur rather quickly.

Most of the natural disasters that occur in Missouri (except for earthquakes, land subsidence, and possibly dam failures) result from a weather extreme or an extreme weather change. Because Missouri is situated in the center of the United States, it is subject to many different influences that determine weather patterns.

According to Dr. Grant Darkow [1], Department of Atmospheric Science at the University of Missouri-Columbia, specific recognizable weather patterns are responsible for Missouri's weather, especially those that "tend to produce extremes in precipitation, resulting in unusually wet or drought conditions, and extremes in temperature, either abnormally warm or cold." Darkow explains, "The character of air over Missouri on any particular day or series of days is dominated by the source regions from which it comes. Missouri's mid-continental location makes it subject to air flows from a variety of source regions with markedly different properties.

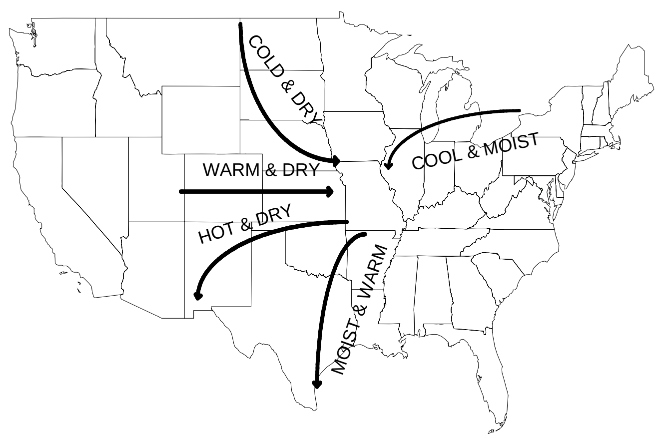
The state is close enough to the Gulf of Mexico that warm air with high humidity can flow into the state from a southerly direction at almost any time of the year. This warm, moist air is the principal source of spring, summer, and fall precipitation and, occasionally, precipitation in winter as well.

In contrast, air arriving over Missouri from semi-arid to arid regions to the southwest is warm or hot and usually dry. Air that has moved from west to east over the Rocky Mountains arrives warm and dry, having lost most of its low-level moisture as it climbed the west side of the mountains.

Abnormally cold air in the winter and cold summer air with only very small moisture content arrives over Missouri from the northwest or north, whereas air entering Missouri from the northeast will tend to be cool and moist." (see Figure 1)

FIGURE 1

SOURCE REGIONS AND ATMOSPHERIC CHARACTERISTICS FOR AIR ARRIVING IN MISSOURI



Darkow goes on to explain, "Normally, the flow from one of the principal source regions will last for two or three days before switching to a different direction and source region. These transitions typically are accompanied by a frontal passage during which the change in wind direction, temperature, and moisture content, or any combination, is concentrated."

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[1]Grant L. Darkow, Missouri Weather Patterns and Their Impact on Agriculture, University Extension, University of Missouri-Columbia.

“In some instances, however, a particular flow pattern may be very persistent or dominant for a period of weeks or even months. These periods can lead to wet, dry, hot, or cold spells, and the extremes associated with these periods. These periods are characterized by particular upper air flow patterns and associated surface weather patterns.” (see Figures 2a, 2b, 3a, 3b, 4a, and 4b).

Figure 2a. Upper Air Pattern (Precipitation Producing)

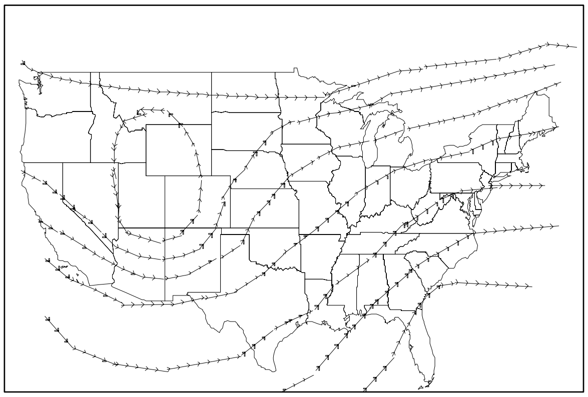


Figure 2b. Surface Air Pattern (Precipitation Producing)

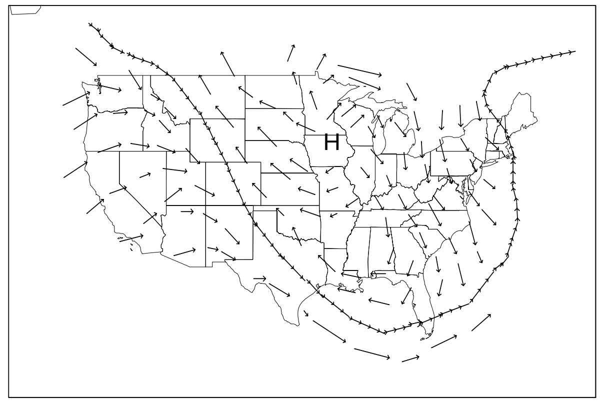


Figure 3a. Upper Air Pattern (Dry To Drought Producing)

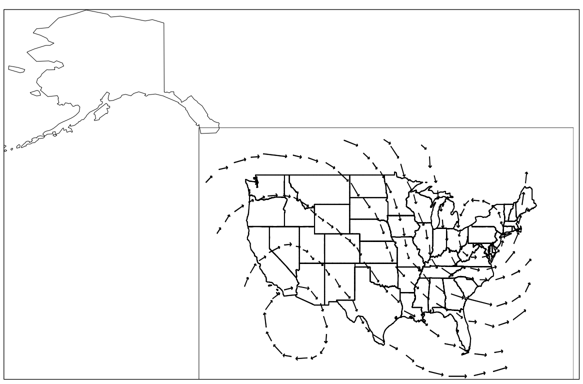


Figure 3b. Surface Air Pattern (Dry to Drought Producing)

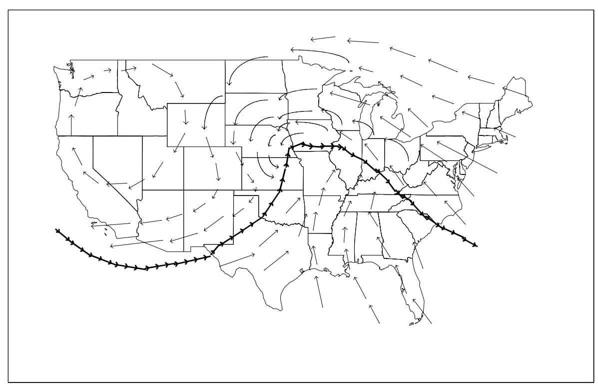


Figure 4a. Upper Air Pattern (Cold-Dry Case)

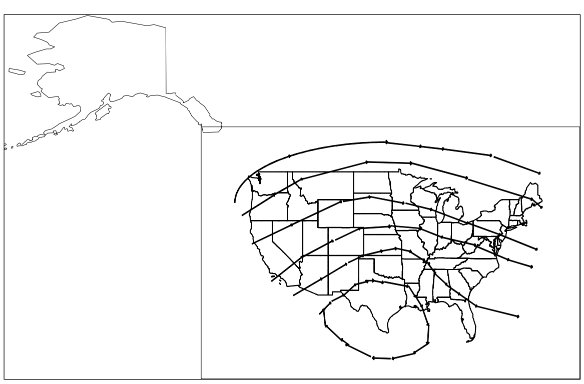
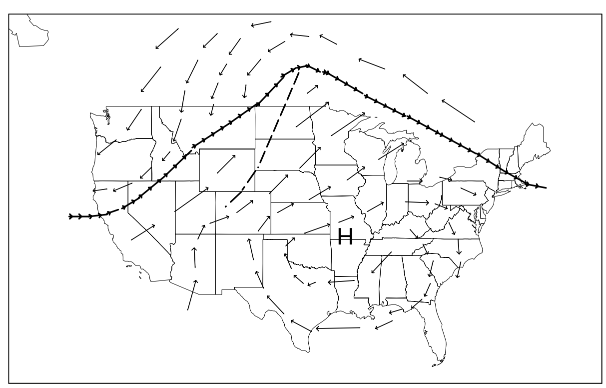


Figure 4b. Surface Air Pattern (Cold-Dry Case)



"The persistence of these weather patterns, and the possible resulting condition is the subject of several of the natural disasters discussed in this study. Specifically, floods, droughts, fires, heat waves, severe cold, and winter storms can be the result of the persistence of one of these weather patterns, whereas tornadoes can represent the outgrowth of rapid shifts in weather patterns. Knowing these patterns may assist in alerting disaster planners and the general public to the possibility of a developing emergency situation."

The Missouri State Emergency Operations Plan (2005) considers natural and man-made disasters, as discussed below.

NATURAL DISASTERS: Natural disasters can be complex, occurring with a wide range of intensities. Some events are instantaneous and offer no window of warning, such as earthquakes. Some offer a short window in which to alert the public to take actions, such as tornadoes or severe thunderstorms. Others occur less frequently and are typically more expansive, with some warning time to allow the public time to prepare, such as flooding. The following natural disasters may threaten Missouri:

- Tornadoes
- Floods
- Water (Interruptions and Drought)
- Earthquakes/Land Subsidence
- Wild Fires (Forest, Prairie, and Grasslands)
- Winter Storms and Severe Cold
- Heat Wave
- Severe Weather.

MAN-MADE DISASTERS: Each year sees an increase in man-made incidents, which can be just as devastating as natural disasters. The following man-made disasters could affect the State of Missouri:

- Structural and Urban Fires
- Utilities (Interruptions and Failures)
- Fixed Facility and Transportation Nuclear Hazards
- Hazardous Materials; Other Environmental Issues
- Mass Transportation Incident
- Nuclear Attack
- Conventional Attack
- Biological and Chemical Attack
- Terrorism
- Sabotage
- Civil Disorder
- Dam Failure
- Public Health Emergencies.

This hazard analysis addresses these man-made disasters.

In the U.S., 95 percent of all presidentially-declared disasters have been related to weather or flood events. In Missouri, 100 percent of the presidentially-declared disasters since 1975 have also been related to weather or flood events.

Table 1 summarizes presidentially-declared disasters in Missouri since 1975.

TABLE 1

PRESIDENTIAL DISASTER DECLARATIONS FOR MISSOURI SINCE 1975

Declaration Date	Incident Type	No. Of Counties Designated	Type of Assistance By County*
May 3, 1975	Tornadoes, High Winds, Hail	4	IA & PA: 4
July 21, 1976	Severe Storms, Flooding	4	IA & PA: 4
September 24, 1976	Drought	94	PA Only: 94
May 7, 1977	Tornadoes, Flooding	7	IA & PA: 7
September 14, 1977	Severe Storms, Flooding	6	IA & PA: 6
March 12, 1979	Ice Jam, Flooding	2	PA Only: 2
April 21, 1979	Tornadoes, Torrential Rains, Flooding	17	IA Only: 1
			IA & PA: 16
May 15, 1980	Severe Storms, Tornadoes	1	IA Only: 1
August 26, 1982	Severe Storms, Flooding	3	IA Only: 1
			IA & PA: 2
December 10, 1982	Severe Storms, Flooding	17	IA Only: 18
			PA Only: 1
			IA & PA: 5
June 21, 1984	Severe Storms, Flooding	11	IA Only: 1
			PA Only: 8
			IA & PA: 2
October 14, 1986	Severe Storms, Flooding	30	IA Only: 7
			PA Only: 15
			IA & PA: 8
May 24, 1990	Severe Storms, Flooding	10	IA Only: 2
			IA & PA: 8
May 11, 1993	Severe Storms, Flooding	8	IA Only: 8
July 9, 1993	Severe Storms, Flooding	102	IA Only: 14
			IA & PA: 88
			(Cities) IA & PA: 3
December 1, 1993	Severe Storms, Tornadoes, Flooding	24	IA Only: 10
			IA and PA: 14
April 21, 1994	Severe Storms, Tornadoes, Flooding	18	IA Only: 18
June 2, 1995	Severe Storms, Tornadoes, Flooding	61	IA Only: 18
			IA & PA: 43
			(Cities) IA Only: 1

Declaration Date	Incident Type	No. Of Counties Designated	Type of Assistance By County*
October 14, 1998	Severe Storms, Flash Flooding	19	IA and PA: 5
			PA Only: 14
Oct. 19, 1998**	Severe Storms, Flash Flooding	2	IA Only: 2
			(Cities) IA Only: 1
April 20, 1999	Storms and Flooding	6	IA Only: 6
May 12, 2000	Thunderstorms, Flooding	10	IA: 10 IA and PA: 3
February 6, 2002	Ice Storm	43	IA Only: 43
			PA Only: 22
			IA and PA: 26
May 6, 2002	Severe Storms, Tornadoes	79	IA Only: 9
			PA Only: 31
			IA and PA: 39
May 6, 2003	Thunderstorms, Tornadoes, Flooding	76	IA Only: 42
			PA Only: 2
			IA and PA: 32
June 11, 2004	Tornado, Severe Storms, Flooding	37	IA: 37
September 10, 2005	Hurricane	114 & City of St. Louis	PA Only
March 16, 2006	Severe Storms, Tornadoes, Flooding	41	IA Only: 12
			PA Only: 8
			IA and PA: 21
April 5, 2006	Severe Storms, Tornadoes, Flooding	7	IA Only: 3
			IA and PA: 4

Notes:
* IA denotes individual assistance; PA denotes public assistance.
** Declaration was for incident in July 1998, and approved October 19, 1998, following State appeal.

Table 2 shows the total amount of public assistance eligible for disaster declarations in Missouri from 1990 through 2006. Public assistance includes state and federal assistance for uninsured losses to public property and infrastructure within those counties included in the disaster declaration.

TABLE 2

PUBLIC ASSISTANCE FOR MISSOURI DISASTERS, 1990-2006

Date	DR No.	Number of Applicants	Damage Survey Reports/Project Worksheets	Total Amount Eligible
Spring 1990	0867	72	2,023	$9,461,555
Summer 1993	0995	901	14,479*	$140,859,657*
Fall 1993	1006	38	565*	$3,281,066*
Spring 1995	1054	329	2,275*	$17,404,027*
Fall 1998	1253	104	869	$11,217,783*
May 12, 2000	1328	31	183	$3,359,091.75
February 6, 2002	1403	247	654	$64,117,837.60

May 6, 2002	1412	338	1679	$47,657,061.62
May 6, 2003	1463	160	552	$21,494,879.54
September 10, 2005	EM 3232	12	22	$1,810,673.71
March 16, 2006	DR 1631	129	249	$7,087,060.37
April 5, 2006	DR 1635	28	110	$8,611,859.32
July 21, 2006	EM 3267	132	70	$2,727,282.97
Totals		2521	4388	$156,865,746.88

Notes:
DR Disaster Declaration
EM Emergency Declaration
* Figures as of June 1999.

Table 3 shows the total amount of individual assistance for individual assistance (IA)-declared disasters in Missouri from 1990 through 2006. Individual assistance includes state and federal assistance to individuals and families for uninsured losses within those counties included in the disaster declaration.

TABLE 3

INDIVIDUAL ASSISTANCE FOR MISSOURI FLOOD DISASTER, 1990-2006

Date	**DR No.**	**Individual Assistance**	**Total Number of Applicants**
Spring 1990	867	$4,000,000	700
Spring 1993	989	$1,591,241	447
Summer 1993	995	$65,690,976	15,478
November 1993	1006	$2,796,562	673
Spring 1994	1023	$2,116,639	779
Spring 1995	1054	$4,297,039	1,868
July 1998	1256	$1,093,865	1,763*
Fall 1998	1253	$1,251,679	1,623*
Spring 1999	1270	$559,725	203*
May 12, 2000	1328	$2,897,685.96	515
February 6, 2002	1403	$3,656,665.11	8,376
May 6, 2002	1412	$8,774,608.35	6,834
June 11, 2004	1524	$1,383,742.88	1,209
March 16, 2006	1631	$1,533,976.15	2,312
April 5, 2006	1635	$2,470,813.97	1,52
Totals		$104,115,218.42	19,299

Notes:

DR Disaster Declaration
* Figures as of June 1999.

Table 4 shows the total projected federal expenditures through September 30, 1994, for four major disasters.

TABLE 4

FEDERAL DISASTER EXPENDITURES

Disaster Incidents	Declaration Date	Projected Federal Expenditures (in Millions of Dollars)*
Hurricane Andrew	August 1992	3937.1
Hurricane Iniki	September 1992	554.2
Midwest Floods	Summer 1993	6011.7
Northridge Earthquake	January 1994	3714.6

Note:

* Expenditures through September 30, 1994.

Declared Disasters

1993 - Present

FOREWORD

Lately, disasters appear to be occurring more frequently than during previous years. Federal, state, and local emergency managers need to prepare for, respond to, and recover from the increasing frequency and scope of disasters. While recent major disasters are memorable, the increased rate of occurrence is remarkable. Disasters in the 1980s were nearly twice as frequent as disasters in the 1970s. From 1993 through 2000 alone, Missouri experienced seven flood disasters, including one that exceeded the once-in-every–500-years flood levels. According to some weather forecasters, the country has entered a period of extremely destructive weather patterns.

The foundation for emergency preparedness is planning how to handle disasters. The art of perfecting how to respond to disasters is enhanced by the ability to bring together the key players for periodic exercises that emulate actual disasters.

This Hazard Analysis should be used by state and local officials to plan and prioritize resource allocations. Local officials can use information in this document to develop their own localized hazard analysis.

POPULATION

Missouri has a surface land area of 68,886 square miles and a population of 5,595,211 (2000 census).

Missouri ranks 17th among the 50 states in population; 18th in land area, and 27th in population density. Within the state are 960 incorporated cities, towns, and villages.

In the 1830 census, it's first, Missouri had a population of 140,455. The 1970 census showed 4,677,623 inhabitants, and the 1980 census showed 4,917,444 residents; in 1990, the census indicated another population increase to 5,117,073; in 2000, the census showed 5,595,211 inhabitants.

The population center of the United States was determined to lie in Phelps County approximate 2.8 miles east of Edgar Springs.

Missouri Population	5,595,211
Area Square Miles	68,886
Population Equivalent per Square Mile	81.2
Number of Incorporated Cities, Towns, and Villages	960
Number of Counties	114
Urban Population	69.4%
Cities with a Population of 50,000 or More	10
Counties with a Population Greater than 500,000 (St. Louis and Jackson)	2
Counties with a Population of 100,000 to 500,000 (Boone, Clay, Greene, Jasper, Jefferson, and St. Charles)	6
Counties with a Population of 50,000 to 100,000 (Buchanan, Cape Girardeau, Cass, Christian, Cole, Franklin, Newton, Platte, St. Francois)	9
Counties with a Population of 25,000 to 50,000	23
Counties with a Population of 15,000 to 25,000	27
Counties with a Population of 10,000 to 15,000	21
Counties with a Population of 1 to 10,000	26

ANNEX A

TORNADOES AND SEVERE THUNDERSTORMS
(DOWNBURSTS, LIGHTNING, HAIL, HEAVY RAINS, WIND)

I. TYPE OF HAZARD

Tornadoes and Severe Thunderstorms (Downbursts, Lightning, Hail, Heavy Rains, Wind).

II. DESCRIPTION OF HAZARD

Tornadoes are cyclical windstorms often associated with the midwestern areas of the United States. Weather conditions conducive to tornadoes often produce a wide range of other dangerous storm activities, including severe thunderstorms, downbursts, straight-line winds, lightning, hail, and heavy rains. For the purpose of this analysis, tornadoes are considered in one category. Other severe weather activities, noted above, are referenced separately in the Synopsis section of this annex (see Part VI).

Essentially, tornadoes are a vortex storm with two components of winds. The first is the rotational winds that can measure up to 500 miles an hour, and the second is an uplifting current of great strength. The dynamic strength of both these currents can cause vacuums that can overpressure structures from the inside. Although tornadoes have been documented in all 50 states, most of them occur in the central United States. The unique geography of the central United States allows for the development of thunderstorms that spawn tornadoes. The jet stream, which is a high-velocity stream of air, determines which area of the central United States will be prone to tornado development. The jet stream normally separates the cold air of the north from the warm air of the south. During the winter, the jet stream flows west to east from Texas to the Carolina coast. As the sun "moves" north, so does the jet stream, which at summer solstice flows from Canada across Lake Superior to Maine. During its move northward in the spring and its recession south during the fall, the jet stream crosses Missouri, causing the large thunderstorms that breed tornadoes.

Tornadoes spawn from the largest thunderstorms. The associated cumulonimbus clouds can reach heights of up to 55,000 feet above ground level, and are commonly formed when gulf air is warmed by solar heating. The moist, warm air is overridden by the dry cool air provided by the jet stream. This cold air presses down on the warm air, preventing it from rising, but only temporarily. Soon, the warm air forces its way through the cool air, and the cool air moves downward past the rising warm air. This air movement, along with the deflection of the earth's surface, can cause the air masses to start rotating. This rotational movement around the location of the breakthrough forms a vortex, or funnel. If the newly created funnel stays in the sky, it is referred to as a funnel cloud. However, if it touches the ground, the funnel officially becomes a tornado.

A typical tornado can be described as a funnel-shaped cloud that is “anchored” to a cloud, usually a cumulonimbus, that is also in contact with the earth's surface. This contact on average lasts 30 minutes and covers an average distance of 15 miles. The width of the tornado (and its path of destruction) is usually about 300 yards. However, tornadoes can stay on the ground for upward of 300 miles and can be up to a mile wide. The National Weather Service, in reviewing tornadoes occurring in Missouri between 1950 and 1996, calculated the mean path length at 2.27 miles and the mean path area at 0.14 square mile.

The average forward speed of a tornado is 30 miles per hour but may vary from nearly stationary to 70 miles per hour. The average tornado moves from southwest to northeast, but tornadoes have been

known to move in any direction. Tornadoes are most likely to occur in the afternoon and evening, but have been known to occur at any hour of the day or night.

Tornadoes are classified according to the F- Scale (developed by Dr.Theodore Fujita, a renowned severe storm researcher). The F- Scale attempts to rank tornadoes according to wind speed based on the damage caused (Table A-1).

TABLE A-1

FUJITA TORNADO DAMAGE SCALE

SCALE	WIND SPEED**(MPH)	TYPICAL DAMAGE
F0	<73	Light damage: Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; signboards damaged.
F1	73-112	Moderate damage: Surface peeled off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage: Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage: Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forests uprooted; heavy cars lifted off the ground and thrown some distance.
F4	207-260	Devastating damage: Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown, and large missiles generated.
F5	261-318	Incredible damage: Strong frame houses leveled off foundations and swept away; automobile-sized missiles propelled through the air more than 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Notes:

Developed in 1971 by T. Theodore Fujita of the University of Chicago.

**Do not use F-scale wind speeds literally. These wind speed numbers are actually estimates and have never been scientifically verified. Different wind speeds may cause similar damage from place to place – even from building to building. Without a thorough engineering analysis of tornado damage in any event, the actual wind speeds needed to cause that damage are unknown.

The National Weather Service, 2003

TABLE A-2

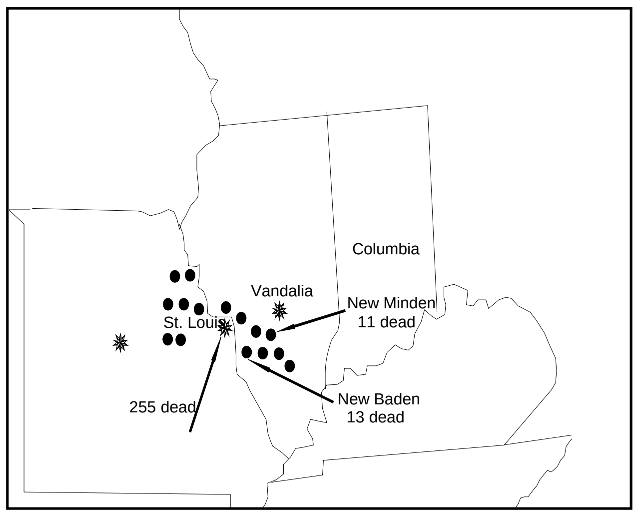
MISSOURI TORNADOES BY F-SCALE, 1950-1996

SCALE	PERCENTAGE
F0	47
F1	24
F2	16
F3	12
F4	1
F5	0

III. HISTORICAL STATISTICS

Historically, the State of Missouri has experienced numerous tornadoes of varied intensities. On May 27, 1896, between the hours of 2 and 8 p.m., a series of 18 tornadoes known as the “St. Louis, Missouri, Outbreak” struck Missouri and Illinois. These tornadoes resulted in 306 deaths and $15 million in damages (see Figure A-1).

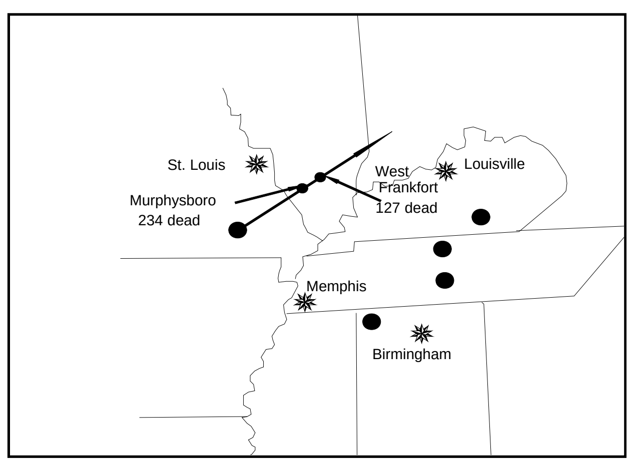
Figure A-1
St. Louis, Missouri, Tornado Outbreak



The National Weather Service reported that 1400 tornadoes had occurred in Missouri from 1950 to 2002, with 160 deaths and over $900 million in damages. This averages 26 tornadoes per year and 3 deaths per year.

The worst tornado in U. S. history, in terms of deaths and destruction, occurred in Missouri on March 18, 1925, between 1 and 6 p.m. (see Figure A-2). The great “tri-state” tornado originated in Reynolds County. It proceeded east-northeast through the southern quarter of Illinois and into Indiana, covering 219 miles. It caused over $18 million in damage, affected six states, and killed 689 persons.

Figure A-2
The Great Tri-State Tornado of 1925

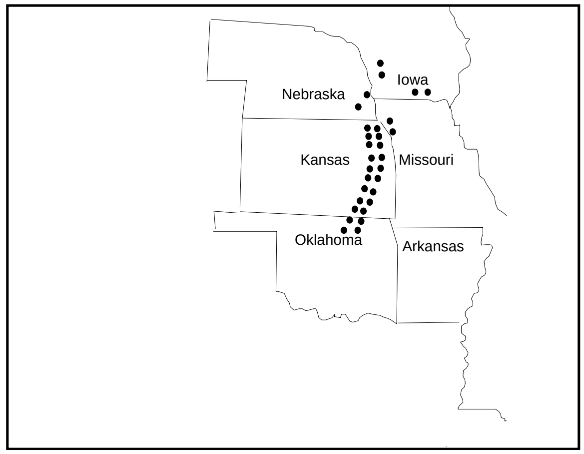


The City of Poplar Bluff, Missouri, was almost wiped out by a tornado on May 9, 1927. This tornado cost 92 lives and $2 million in damages. The same day, two severe tornadoes struck St. Louis, Missouri. The first tornado moved across the entire city from the western city limits to the Mississippi River through the Lafayette Park area, killing 306 people in Missouri and Illinois and causing almost $13 million in damages. The second tornado started in the southwestern part of the city and proceeded through the Tower Grove

and Vanderventer areas, then on to Granite City, Illinois. Seventy-nine people were killed, and about $23 million in damages resulted from this storm.

During the afternoon and evening of April 3, and the early morning of April 4, 1974, a "super outbreak" of 148 tornadoes across 13 states killed more than 300 people, injured more than 6,000 and caused $600 million in damages (see Figure 3).

Figure A-3
The Tornado Super Outbreak in 1974

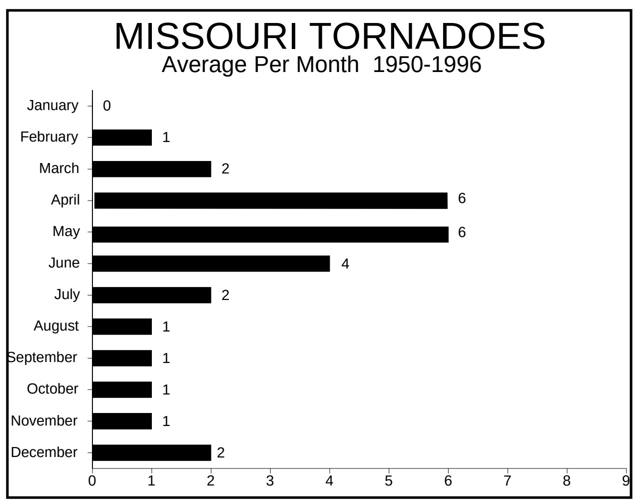


On the afternoon of April 26, and the early morning of April 27, 1991, an outbreak of 54 tornadoes covering six states, including Missouri, resulted in 21 deaths, 308 injuries, and damages exceeding $277 million. There were two deaths in vehicles and 15 deaths in and near mobile homes.

On July 4, 1995, at approximately 5:40 p.m., a tornado struck the Randolph County community of Moberly. The initial touchdown of the storm was south of town. The storm then moved through the eastern half of the community. The tornado uplifted approximately 7 miles northeast of Moberly. At least 15 people were injured, 25 businesses damaged, along with the courthouse, and some 300 families affected. This resulted in a Small Business Administration disaster declaration for low interest loans. The tornado was characterized by the National Weather Service as a class F3 tornado.

Figure A-4 shows that tornadoes in Missouri occur most frequently between April and June, with April and May usually producing the most tornadoes. However, tornadoes can occur any time of the year, such as the storms that struck in St. Charles and Barry Counties in November 1988.

Figure A-4



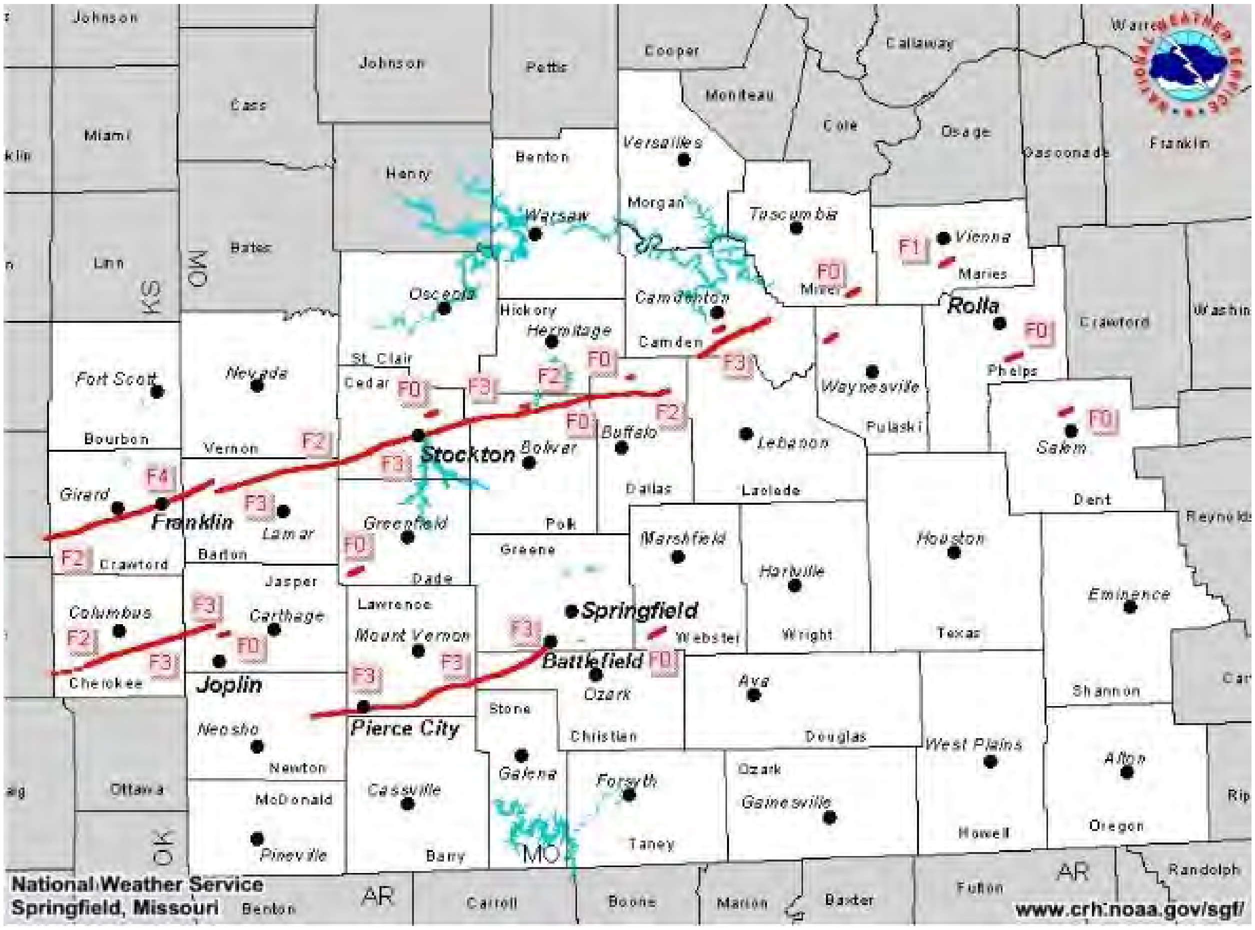


Figure A-5 Map of the May 4, 2003 Tornados

A record 84 tornadoes were recorded in Missouri in 2003. During the week of May 4, 2003, 79 of those tornadoes occurred and mostly in the southwest portion of Missouri. There were several F4 tornadoes which occurred on May 4 in Platt, Clay and Barton counties. There were nineteen people killed by the tornadoes in Southwest Missouri. That is the highest total since 1959 when 21 were killed. It is only the fourth year in which double digit deaths from tornadoes occurred in Missouri since 1950. The killer tornadoes all occurred on May 4th. The tornadoes which hit Newton, Lawrence, Christian and Greene counties killed 7 people. Five people were killed by a tornado which hit Cedar and Dallas counties. A tornado which hit Camden county killed 4 people, two people died from a tornado in Jasper county and one person died in Barton county. The tornadoes injured 171 people. That is the highest total since 310 were injured in 1957. See map in Figure A-5. This information provided by the NWS.

The year 2006 was a record year for tornadoes and severe weather outbreaks for Missouri. Beginning March 8th through September 23rd, four sets of major storms went through the state. March 8 – 13 was declared DR 1631 by FEMA for IA and PA, March 30 – April 2 was declared DR 1635 by FEMA for IA and PA (Categories A and B), July 19 – 21 was declared DR 3267 for PA (Categories A and B), and September 22-23 is in the appeal process for declaration.

For a listing of Missouri tornados that resulted in federal disaster declarations since 1975, see Table A-3 in Section VII.

IV. MEASURE OF PROBABILITY AND SEVERITY

The United States has 10 times more tornadoes than any other nation in the world. Missouri averages 26 tornadoes per year, and has recorded 1,400 tornadoes from 1950 through 2002. Missourians have a high probability that tornadoes will continue to affect their lives. The natural phenomena that create tornadoes will continue to occur beyond our ability to control them.

The enormous power and destructive capability of tornadoes are beyond mankind's capabilities to control. The potential severity of effects from tornadoes will continue to be high. We will continue to experience deaths, injuries, and property damages from tornadoes. However, technological advances will facilitate earlier warnings than previously available. This, combined with a vigorous public education program and improved construction techniques, provides the potential for significant reductions in the number of deaths and injuries, as well as reduced property damage.

V. IMPACT OF THE HAZARD

Every tornado is a potential killer, and many are capable of great destruction. Tornadoes can topple buildings, roll mobile homes, uproot trees, hurl people and animals through the air for hundreds of yards, and fill the air with lethal, windblown debris. Sticks, glass, roofing material, and lawn furniture all become deadly missiles when driven by tornado winds. In 1975, a Mississippi tornado carried a home freezer for more than a mile. Once, a tornado in Broken Bow, Oklahoma, carried a motel sign 30 miles and dropped it in Arkansas. Tornadoes do their destructive work through the combined action of their strong rotary winds and the impact of windblown debris. In the most simple case, the force of the tornado's winds push the windward wall of a building inward. The roof is lifted up, and the other walls fall outward. Until recently, this damage pattern led to the incorrect belief that the structure had exploded as a result of the atmospheric pressure drop associated with the tornado.

VI. SYNOPSIS

Tornadoes are usually associated with severe thunderstorms, which by themselves, possess destructive potential. Such storms most often occur in the spring and summer, during the afternoon and evenings, but can occur at any time. In addition to tornadoes, other hazards associated with thunderstorms include the following:

- Damaging winds
- Lightning and resulting fires
- Hail
- Heavy rains causing flash flooding.

The damaging winds of thunderstorms include downbursts, microbursts, and straight-line winds. Downbursts are localized currents of air blasting down from a thunderstorm, which induce an outward burst of damaging wind on or near the ground. Microbursts are minimized downbursts covering an area of less than 2.5 miles across. They include a strong wind shear (a rapid change in the direction of wind over a short distance) near the surface. Microbursts may or may not include precipitation and can produce winds at speeds of more than 150 miles per hour.

In May 1996, a Memorial Day weekend storm identified by the National Weather Service as a microburst caused more than $10 million in damage to homes in Lee’s Summit, Missouri. The storm destroyed at least 13 homes and damaged more than 100 others in several Lee’s Summit subdivisions. The city also incurred a substantial cost for debris removal and cleanup activities resulting from this devastating storm.

Damaging straight-line winds are high winds across a wide area that can reach speeds of 140 miles per hour. Large hail can reach the size of grapefruit. Hail causes several hundred millions of dollars in damage annually to property and crops across the nation. In addition, lightning kills 75 to 100 people each year. During the period of 1992 through 1996, seven people died in Missouri as a result of lightning strikes, compared to two deaths from tornadoes during the same period. The thunderstorms associated with tornado development also contribute to the number one weather killer–flash floods. Flash flooding causes 146 deaths annually throughout the nation. During the period from 1992 through 2002, flooding and flash floods claimed the lives of 60 Missourians. Thunderstorms and severe winds claimed five lives over this same period.

VII. MAPS OR OTHER ATTACHMENTS

The following charts and maps depict additional Missouri tornado information, generally for the period between 1950 and 2000:

- Disaster Declarations For Missouri Tornadoes Since 1975: Table A-3
- Missouri Tornadoes by County, Top Twenty-Five, 1950-2003: Figure A-5
- Missouri Tornadoes by County, 1950-2005: Figure A-6
- Missouri Tornado Deaths by County, Top Ten, 1950-2003: Figure A-7
- Missouri Tornado Deaths by County, 1950-2005: Figure A-8
- Missouri Tornado Statistics, 1950-2005: Table A-4
- Spring 2003 Tornados: Figure A-9
- Spring 2004 Tornados: Figure A-10
- Disaster Assistance by County, March 2006: Figure A-11
- Disaster Assistance by County, April 2006: Figure A-12
- Disaster Assistance by County, July 2006: Figure A-13
- Disaster Assistance by County, September 2006: Figure A-14

TABLE A-3

DISASTER DECLARATIONS FOR MISSOURI TORNADOES SINCE 1975

DATE	INCIDENT TYPE	COUNTIES DECLARED	TYPE OF ASSISTANCE
May 3, 1975	Tornadoes, High Winds, Hail	Caldwell, Newton, Macon, Shelby	PA & IA
May 7, 1977	Tornadoes, Flooding	Carroll, Clay, Lafayette, Ray, Cass, Jackson, Pettis	PA & IA
May 15, 1980	Severe Storms, Tornadoes	Pettis	IA Only
May 1986	Tornadoes	Scott, Mississippi, Cape Girardeau, Perry	SBA Loans
November 1988	Tornadoes	St. Charles, Barry	SBA Loans
July 1995	Tornadoes	Randolph, (City of Moberly)	SBA Loans
May 6, 2003	Tornadoes, Severe Storms, Flooding	Barry, Barton, Bates, Benton, Bollinger, Buchanan, Camden, Cape, Cass, Cedar, Christian, Clay, Clinton, Cooper, Crawford, Dade, Dallas, Dent, Douglas, Franklin, Knox, Gasconade, Girardeau, Greene, Henry, Hickory, Iron, Jackson, Jasper, Jefferson, Johnson, Laclede, Lafayette, Lawrence, McDonald, Miller, Monroe, Morgan, Newton, Osage, Perry Pettis, Phelps, Platte, Polk, Pulaski, Ray, St. Francois, St. Louis, Sainte Genevieve, Saline, Scott, St. Clair, Stoddard, Stone, Taney, Vernon, Washington, Webster	IA
May 6, 2003	Tornadoes, Severe Storms, Flooding	Bollinger, Crawford, Franklin, Gasconade, Knox, Maries, Miller, Oregon, Osage, Pulaski, Washington	PA
June 10, 2004	Tornadoes, Severe Storms, Flooding	Adair, Andrew, Bates, Benton, Caldwell, Carroll, Cass, Cedar, Chariton, Clay, Clinton, Daviess, DeKalb, Gentry, Grundy, Harrison, Henry, Hickory, Jackson, Johnson, Knox, Linn, Livingston, Macon, Mercer, Monroe, Nodaway, Platte, Polk, Randolph, Ray, Shelby, St. Clair, Sullivan, Vernon, and Worth	IA
March 16, 2006	Tornadoes, Severe Storms	Bates, Benton, Boone, Carroll, Cass, Cedar, Christian, Cooper, Crawford, Greene, Henry, Hickory, Howard, Iron, Jefferson, Johnson, Lawrence, Lincoln, Mississippi, Monroe, Montgomery, Morgan, NJew Madrid, Newton, Perry, Pettis, Phelps, Putnam, Randolph, St. Clair, Ste. Genevieve, Scott, Saline, Taney, Vernon, Webster, Wright	IA
March 16, 2006	Tornadoes, Severe Storms	Bates, Bollinger, Benton, Boone, Carroll, Cedar, Christian, Davies, Greene, Henry, Hickory, Howard, Iron, Lawrence, Monroe, Montgomery, Morgan, Perry, Pettis, Putnam, Randolph, Ray, Saline, St. Clair, Vernon, Washington, Webster, Wright	PA
April 5, 2006	Tornadoes, Severe Storms	Andrew, Butler, Dunklin, Pemiscot, St. Francois, Stoddard	IA
April 5, 2006	Tornadoes, Severe Storms	Jefferson, Andrew, Pettis, Pemiscot, St. Francis	PA

DATE	INCIDENT TYPE	COUNTIES DECLARED	TYPE OF ASSISTANCE
July 21, 2006	Tornadoes, Severe Storms	St. Louis County, St. Louis City, Dent, Iron, Jefferson, St. Charles, Washington	PA

Notes:

IA Individual Assistance
PA Public Assistance
SBA Small Business Administration

FIGURE A-5

MISSOURI TORNADOES BY COUNTY
TOP TWENTY-FIVE – 1950-2005

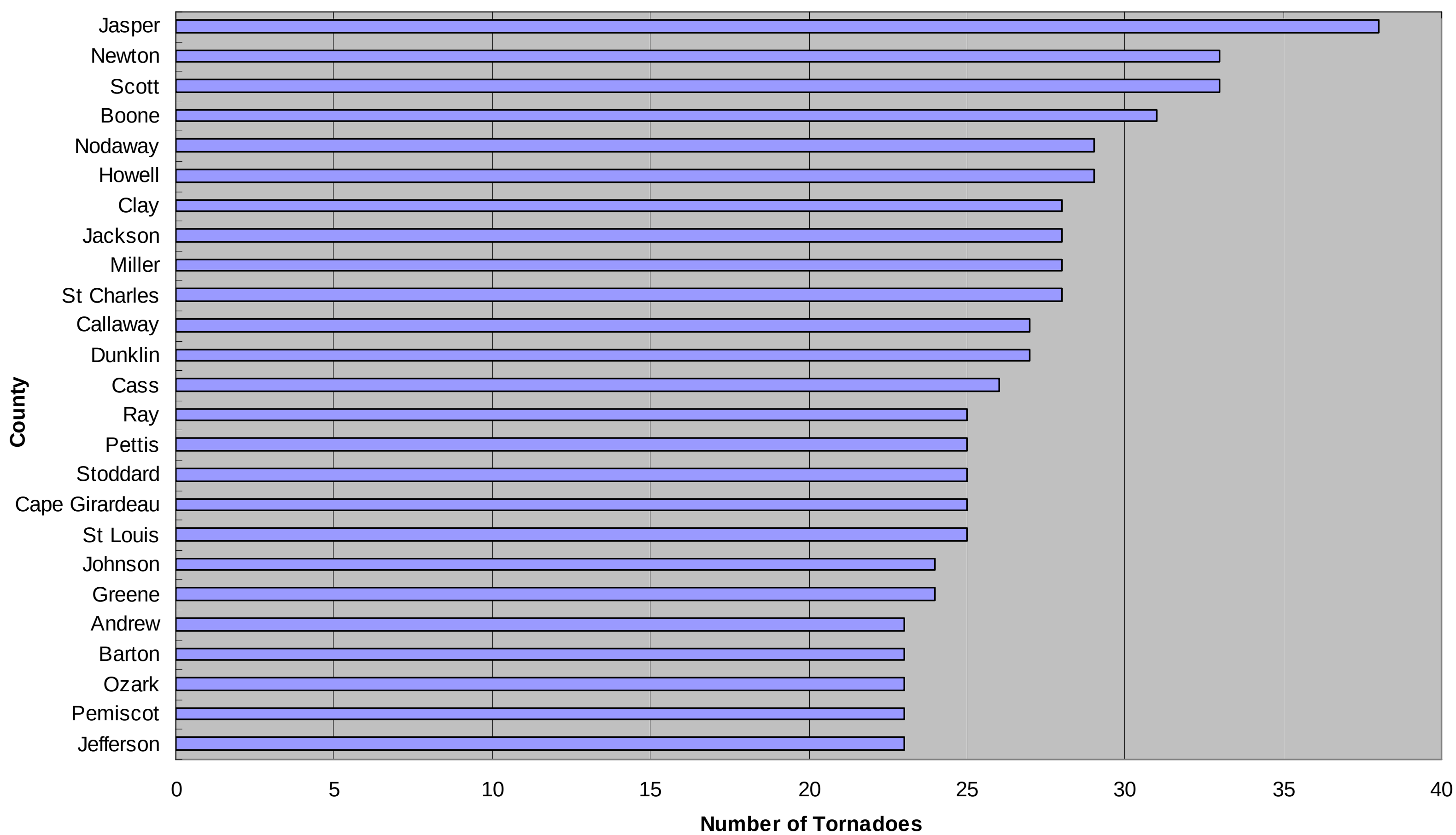


FIGURE A-6

MISSOURI TORNADOES BY COUNTY (1950-2005)

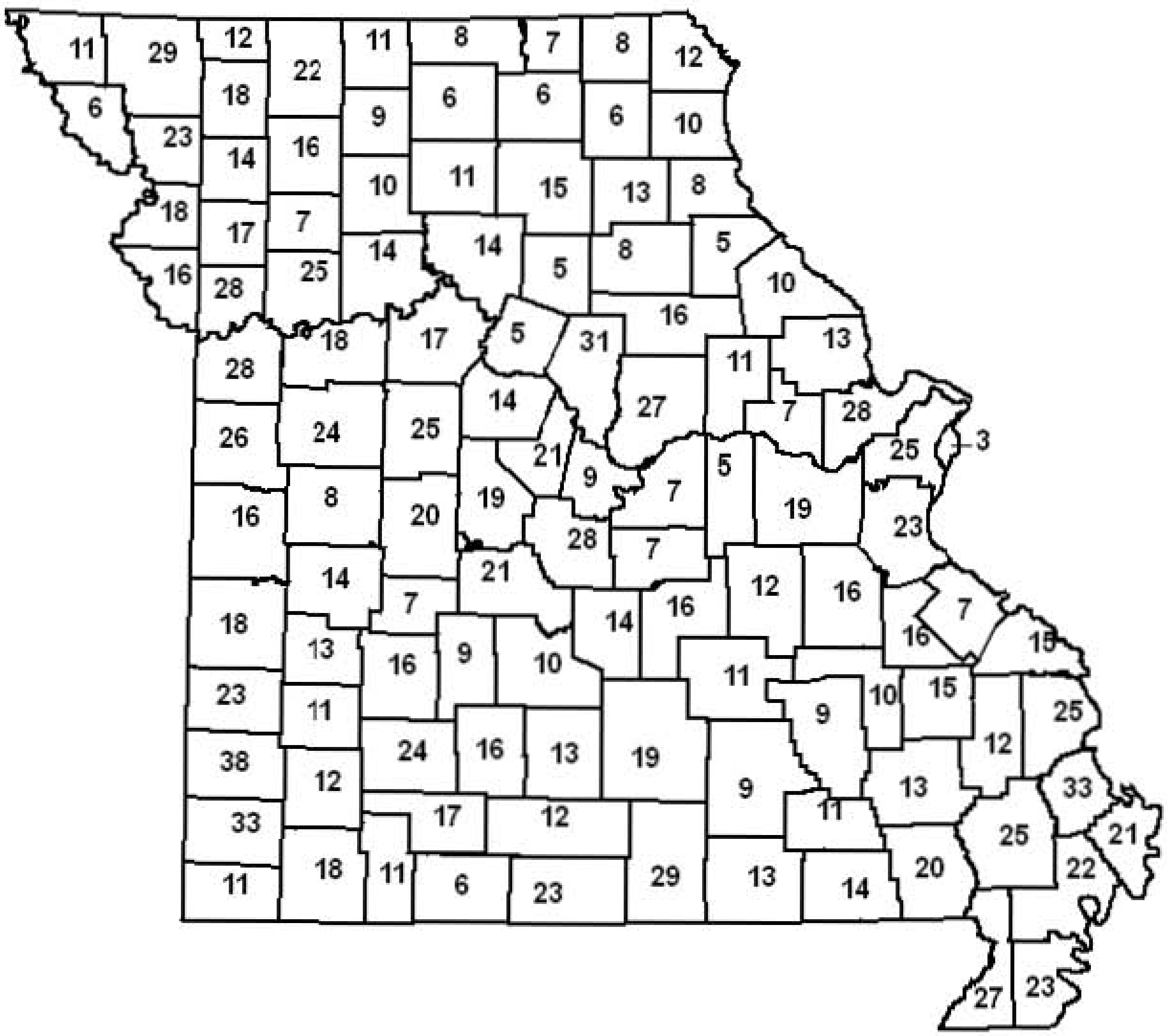


FIGURE A-7

MISSOURI TORNADO DEATHS BY COUNTY
TOP TEN 1950-2005

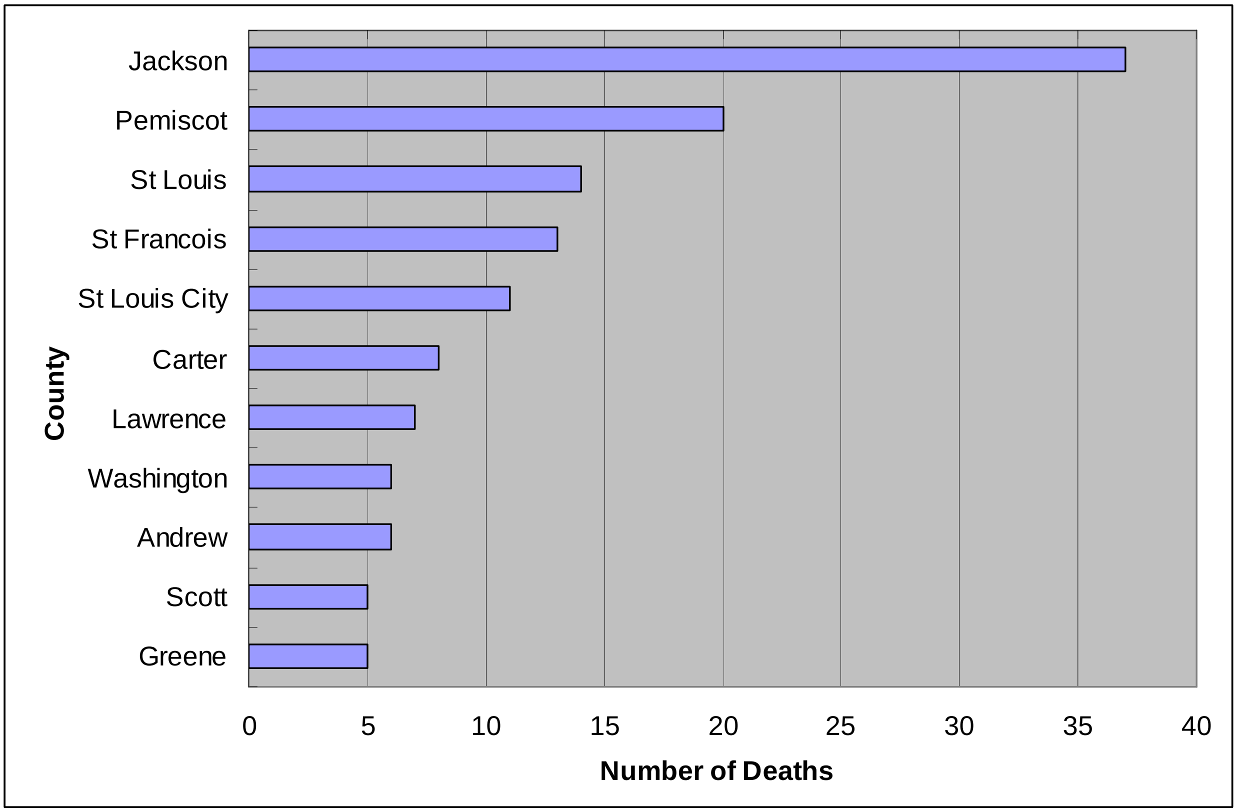


FIGURE A-8

MISSOURI TORNADO DEATHS BY COUNTY (1950-2005)

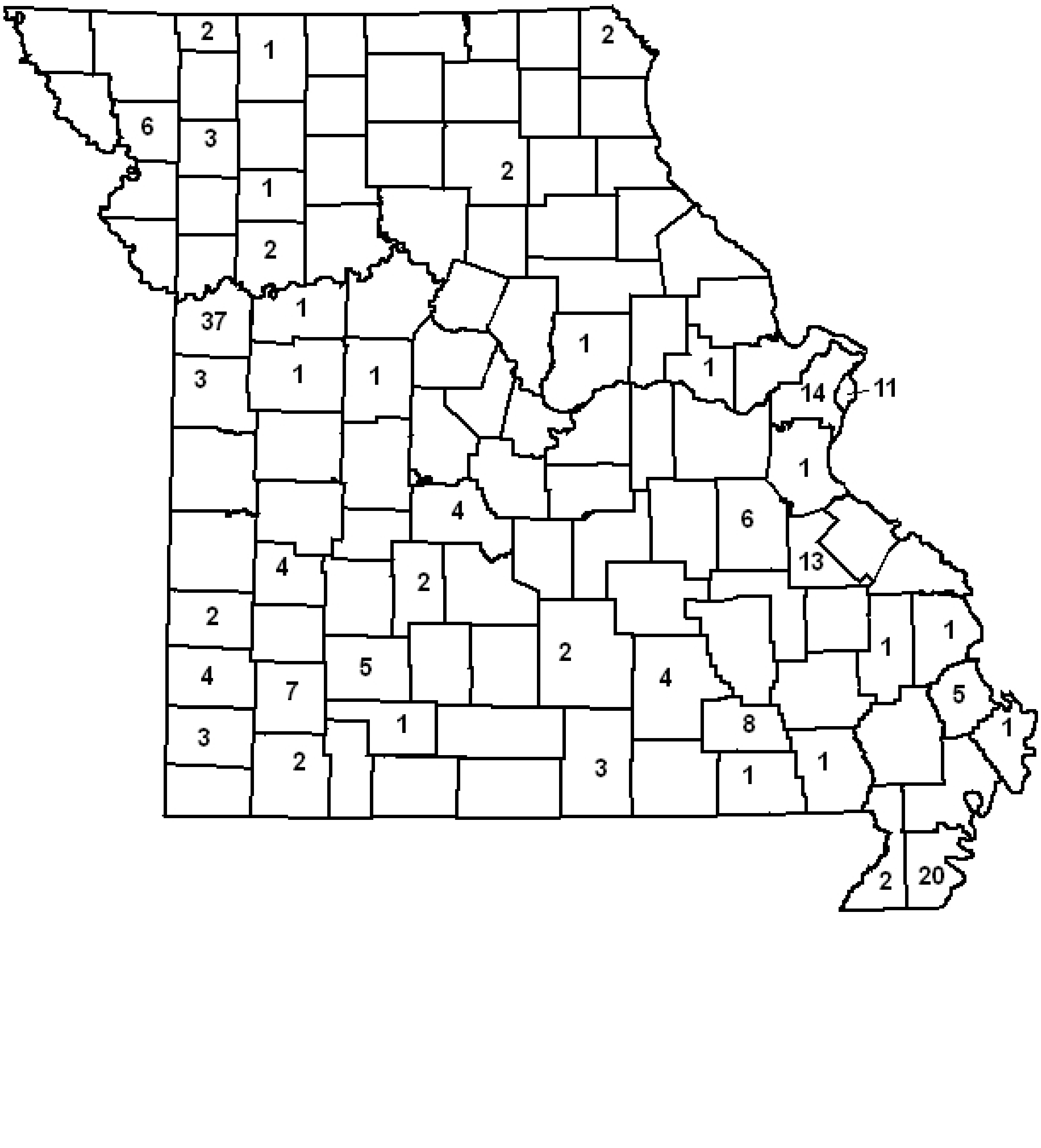


TABLE A-4

MISSOURI TORNADO STATISTICS
1950 – 2005

Total Number of Tornadoes	1,584
Total Number of Deaths	187
Total Number of Injuries	2,566
Yearly Average of Tornadoes	28
Yearly Average of Deaths	3
Yearly Average of Injuries	46
Tornado Deaths 1916 - 2006	774

FIGURE A-9

SPRING 2003 TORNADOS

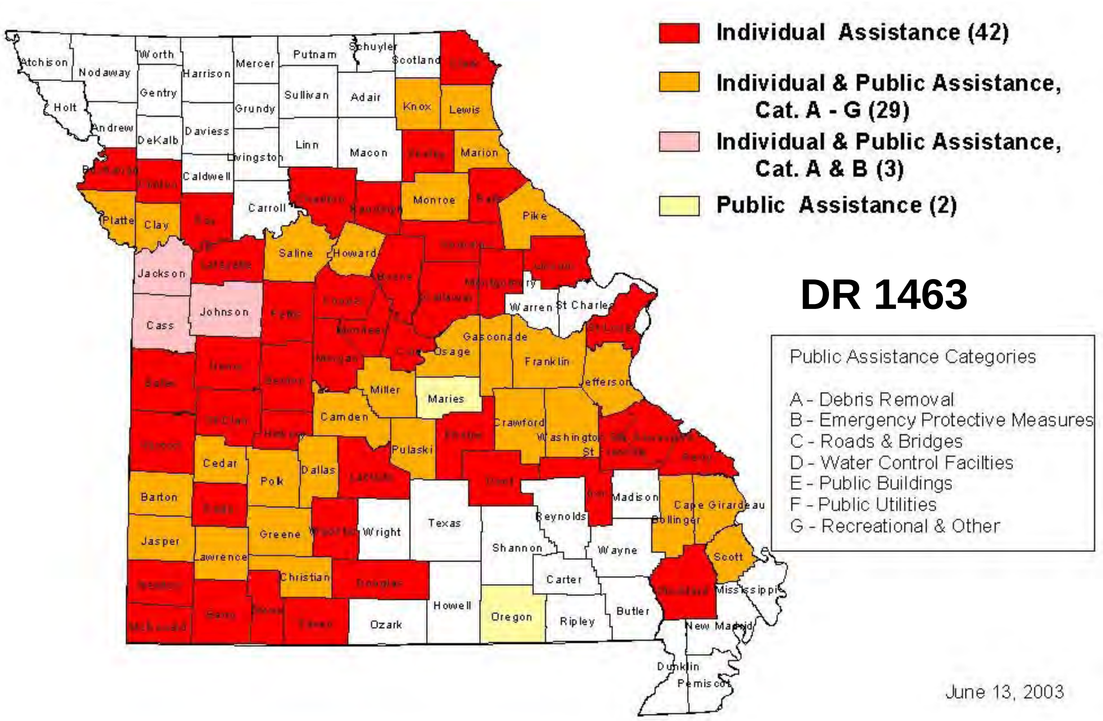


Figure A-10

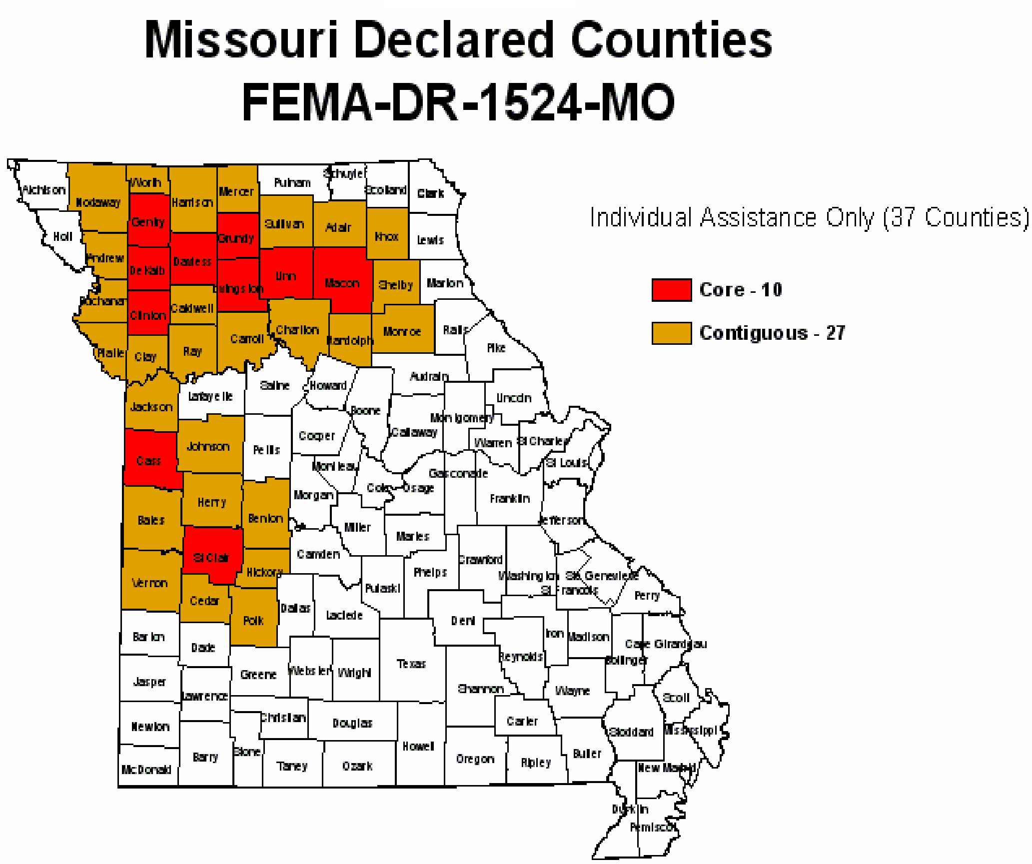


Figure A-11

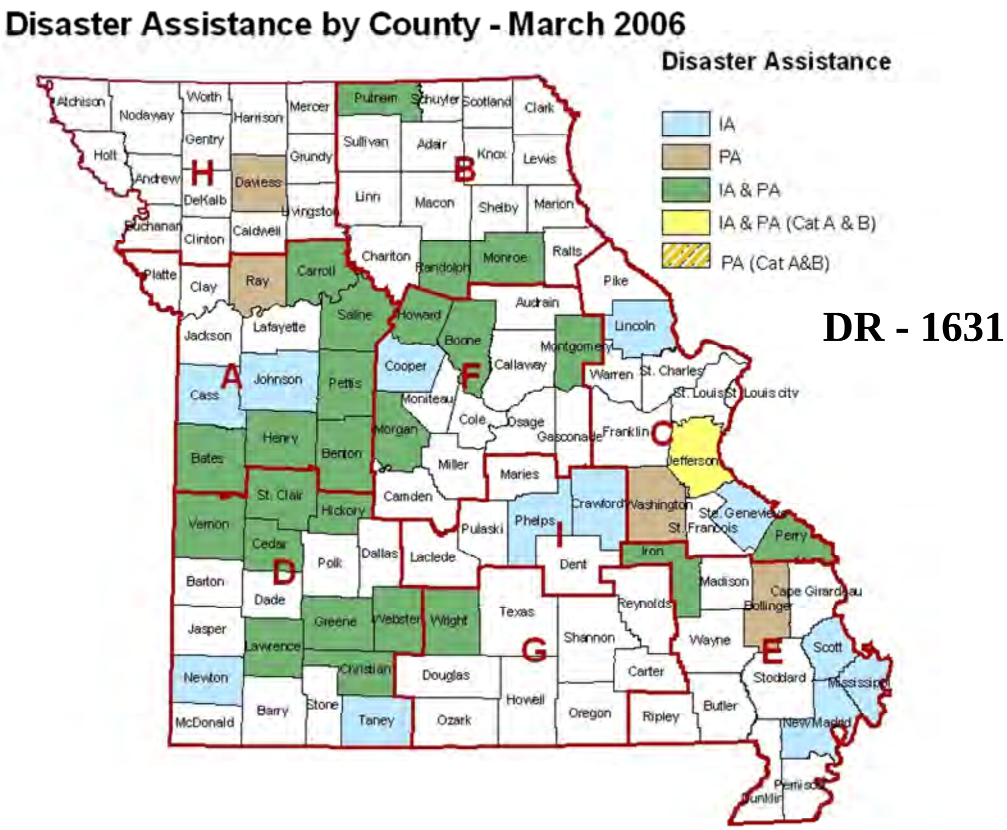


Figure A-12

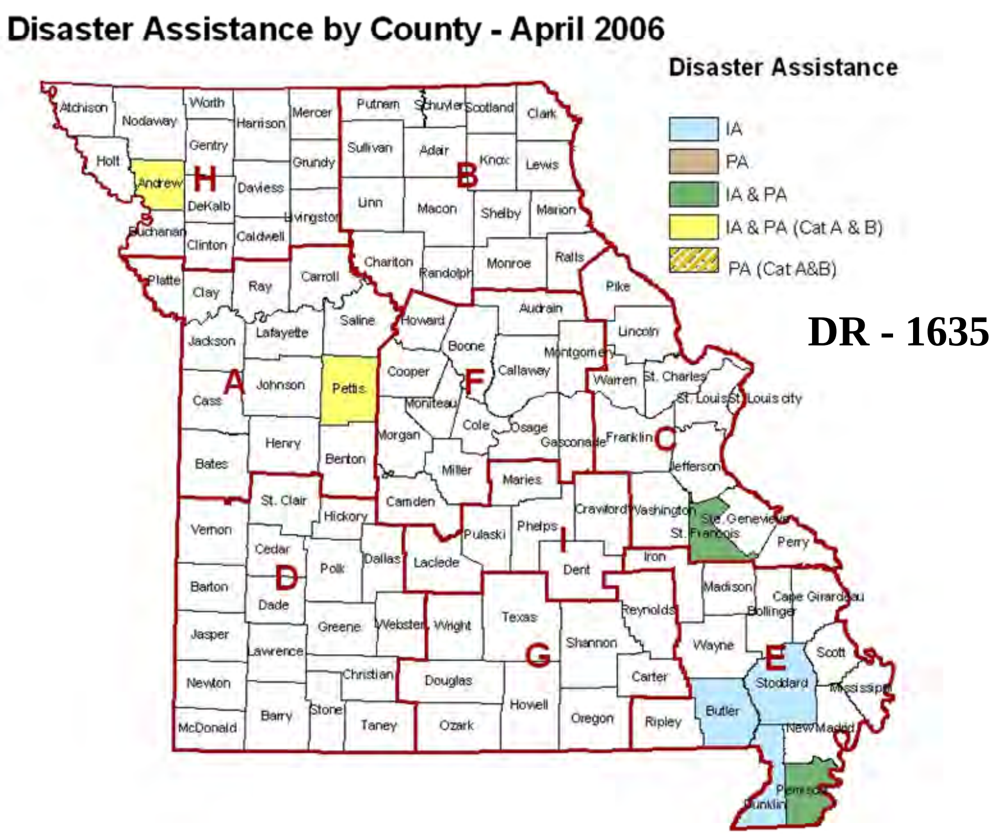


Figure A-13

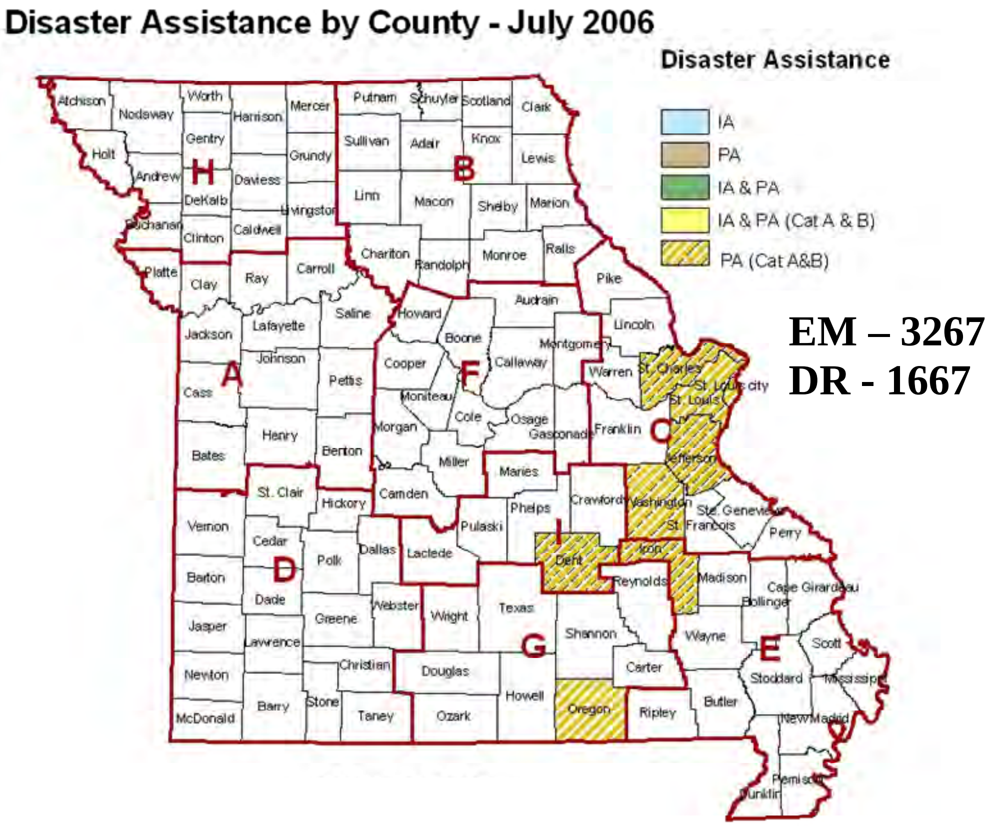
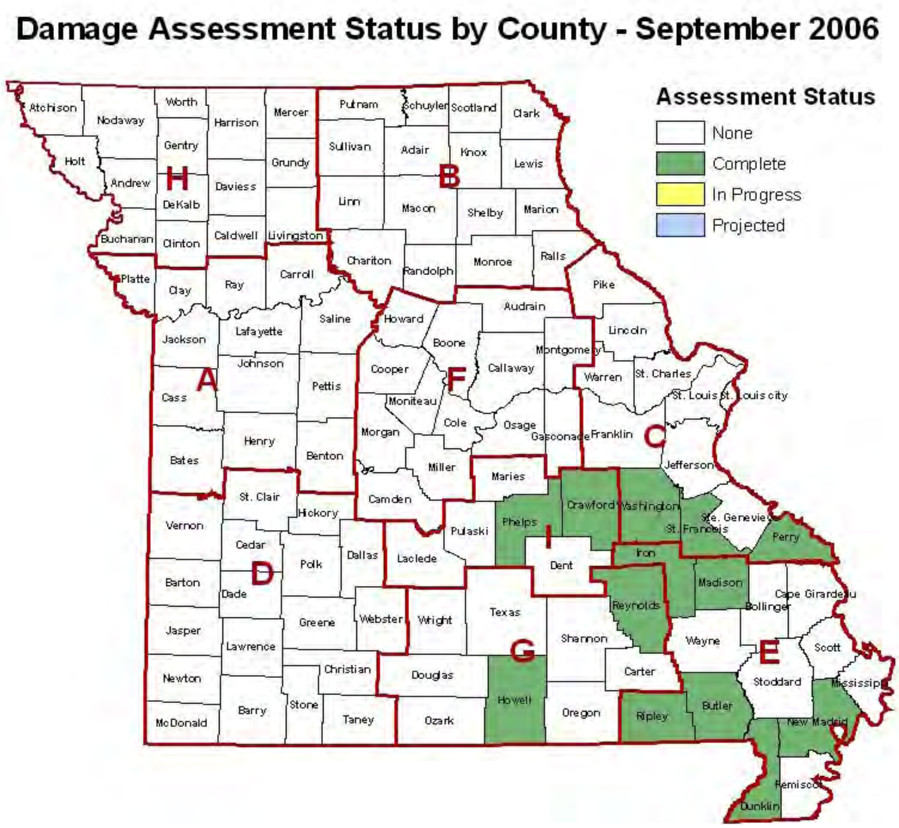


Figure A-14



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National Weather Service (NWS) www.noaa.gov/lsx

ANNEX B

RIVERINE FLOODING
(INCLUDES FLASH FLOODS)

I. TYPE OF HAZARD

Riverine Flooding

II. DESCRIPTION OF HAZARD

Floods are the number one weather-related killer in the United States. Between 1990 and 2004, Missouri recorded more than 82 deaths attributed to flooding. A flood is partial or complete inundation of normally dry land areas. Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snowmelt, or ice. There are several types of riverine floods, including headwater, backwater, interior drainage, and flash flooding. Flash flooding is characterized by rapid accumulation or runoff of surface waters from any source. This type of flooding impacts smaller rivers, creeks, and streams and can occur as a result of dams being breached or overtopped. Because flash floods can develop in a matter of hours, most flood-related deaths result from this type of event.

The areas adjacent to rivers and stream banks that carry excess floodwater during rapid runoff are called floodplains. A floodplain is defined as the lowland and relatively flat area adjoining a river or stream. The terms “base flood” and “100-year flood” refer to the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year, based on historical records. Floodplains are a vital part of a larger entity called a basin, which is defined as all the land drained by a river and its branches.

The land that forms the State of Missouri is contained within the Mississippi, Missouri, Arkansas, and White River Basins. The Mississippi River Basin drains the eastern part of the state, the Missouri River Basin drains most of the northern and central part of the state, the White River Basin drains the south-central part of the state, and the Arkansas River Basin drains the southwest part of the state. The Missouri River Basin drains over half the state. When the Missouri River joins the Mississippi River at St. Louis, it becomes part of the Mississippi River Basin, which is the largest basin, in terms of volume of water drained, on the North American continent.

In some cases, flooding may not be directly attributable to a river, stream, or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall or snowmelt, saturated ground, and inadequate drainage. With no place to go, the water will find the lowest elevations–areas that are often not in a floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the tremendous flow of water that often accompanies storm events. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns.

III. HISTORICAL STATISTICS

Missouri has a long and active history of extensive flooding over the past century. Scores of river communities, such as those along the Mississippi and Missouri Rivers, have become quite skilled and

experienced in flood-fighting efforts due to frequent instances of severe flooding in recent years. Flooding along Missouri's major rivers generally results in slow moving disasters. River crest levels are forecast several days in advance, allowing communities downstream sufficient time to take protective measures, such as sandbagging and evacuations. Nevertheless, these flood disasters extract a heavy toll in terms of human suffering and extensive losses to public and private property. By contrast, flash flood events in recent years have caused a higher number of deaths and major property damage in many areas of Missouri.

Ranking among the state's most notable flood disasters are the Missouri River flood of 1927, which spread destruction across 17 million acres, and the flood of 1951, which caused an estimated $400 million in damage. Record flooding also occurred in 1973 along the Mississippi River, where backwater inundated 474,000 acres at a loss of $40 million. The unseasonably heavy rainfall produced severe headwater flooding along many of the area's tributary streams, particularly in the St. John's Basin in Missouri and along the St. Francis and White Rivers in Arkansas. Of special historic interest is the December 1982 flood that spread dioxin-contaminated soil in the Times Beach area near St. Louis and led to a federal buyout of the entire town. In the fall of 1986, record flooding returned in Missouri, as well as in Michigan, Illinois, Kansas, and Oklahoma, with all these states declared federal disaster areas. Significant flooding next occurred in the state in the spring of 1990, particularly along the Missouri River in western, central, and portions of eastern Missouri. Record-level, repetitive flooding occurred from1993 through1995, and flash flooding ravaged several areas of the state in July and October 1998. In the springs of 1999 and 2000, flash flooding and severe storms again battered portions of the state.

Note: Counties designated as Disaster Areas in the 1993-1995, 1998, 1999, and 2000 floods are identified on maps in Section VII of this annex.

Floods of 1993-1995

The floods of 1993 through 1995 represent Missouri's worst repetitive flood events. Within this time frame were five Presidential Disaster Declarations, including four in just one 12-month period. This period extended from May 6, 1993, when the first declaration was issued by President Clinton, to April 17, 1994, when the fourth declaration was approved. Flooding in the spring of 1995 resulted in a fifth disaster declaration, issued on June 2, 1995. The ravages of these floods left a legacy of destruction, human suffering, and property damage of unprecedented terms in Missouri history. The fact that Missouri would need several years to recover from these repetitive flood disasters was undisputed. In 1993 alone, a total of 112 of Missouri's 114 counties were included in at least one or more of the declarations. Only Cedar County in southwest Missouri and Dunklin County in the southeast portion of the state were not included in any of the 1993 declarations.

Floods of 1998

Severe flash flooding in the summer and fall of 1998 took a heavy toll in terms of lives lost and extensive property damage in several areas of the state. In all, at least 17 people died as a result of the two flood events. Almost all of the casualties occurred when people attempted to drive their vehicles through rushing water, overturned their vehicle into floodwaters, or were trapped and swept off a flooded bridge. Both flood incidents ultimately resulted in Presidential Disaster Declarations to provide state and federal assistance in the declared counties.

Spring 1999 and 2000 Floods

On April 3, 1999, a heavy rainstorm in southeast Missouri caused severe flash flooding in Madison County, including the communities of Fredericktown and Marquand. One death (due to electrocution)

was attributed to that flood event when 7 to 10 inches of rain fell over a 2-hour period, causing the St. Francois River to crest at twice the height of flood stage. More than 400 homes were adversely affected, with nearly half receiving significant water damage within the living spaces. Seven businesses were damaged, and five were determined to be destroyed. On April 20, 1999, a Presidential Disaster Declaration for individual assistance (MO-DR 1270) was approved for Madison County and five additional counties (Andrew, Cole, Osage, Iron, and Macon) were later approved by FEMA as add-ons to that declaration as a result of subsequent tornadoes and storms. More than 30 Missouri counties were also designated as eligible for disaster relief for agricultural losses suffered from the April storms.

For two consecutive spring seasons, Missouri experienced devastating flash flooding that forced hundreds of people from their homes and caused millions of dollars in property damage to both homes and businesses. Although the flash flooding in both events was confined to few areas, the type of devastation was equal or greater than some of Missouri's worst river flooding events. On May 6 and 7, 2000, a slow-moving storm unleashed 15 inches of rain in Franklin and Jefferson Counties in less than 24 hours. The city of Union in Franklin County was among the hardest hit due to extreme flooding from Flat Creek. In all, 10 counties were included in Presidential Disaster Declaration MO DR 1328, issued on May 12, 2000. Three counties were declared eligible for public assistance and individual assistance, and seven others were declared for individual assistance.

Spring 2003

Flash flooding occurred on May 7th and 8th, and became a major flooding event across all of southern and central Missouri through the early afternoon of May 9th. In addition to the numerous road closures, bridges blocked by debris, evacuations of towns, campgrounds, parks, and moderate river flooding, many communities had their worst flooding in more than 10 years. In Howell County, the most significant damage occurred after the Warm Fork River washed out a portion of train track four miles southeast of West Plains, resulting in a train derailment. Four locomotives, each weighing 260,000 pounds, and 10 railroad cars were knocked off the tracks allowing diesel fuel to flow freely onto the ground. In addition to all of the flash flooding reports, river flooding became significant as all of the southern Missouri rivers rose above flood stage by the middle of May. Some of the rivers crested at levels equivalent to the 1993 flood event.

Flood of 2004

The month of May 2004 saw severe storms containing heavy rains and large hail. A strong storm moved through the state from West to East, roughly along the Interstate 70 corridor during the night of 18 – 19 May. The most severe hit area appeared to be in Cass County South of Kansas City. Twenty-two homes were evacuated in Freeman and Lake Annett in Cass County as a result of major flash flooding.

IV. MEASURE OF PROBABILITY AND SEVERITY

In terms of overall damage, Missouri's most severe single hazard is flooding. While the state averages some 26 tornadoes each year, damage is generally confined to small areas with few fatalities, if any. By contrast, flooding has resulted in more federal disaster declarations in Missouri than any other hazard in the past three decades. Prior to the Great Floods of 1993, Missouri received federal disaster declarations due to flooding in the spring of 1990, October 1986, June 1984, December 1982, August 1982 (Jackson County), April 1979, September 1977, July 1976, June 1974, and for extensive flooding in April 1973 and again in November 1973.

Missouri's vulnerability to flooding is greatly increased because it is subject to flooding from two principal sources: the Missouri River Basin and the upper Mississippi River Basin. Over one-third of the annual monetary losses due to flooding in the Missouri River Basin occur within the State of Missouri.

Flash flooding can occur virtually anywhere in the state experiencing an abundance of rainfall in a very short time span, as with the November 1993 flood disaster, and floods of 1998 and 1999. The backing up of tributary stream flows creates flooding problems along the Mississippi River, especially in the southern area of the state where the land tends to be very flat and at low elevations. Even though many flood control projects have been implemented and directly aid in flood prevention, the state is still flood prone due to its geography and location.

The National Weather Service has three response levels for alerting the public as to the danger of floods, as described below:

Response Level	Activity
Flood Watch	Flash flooding or flooding is possible within the designated area.
Flood Warning	Flash flooding or flooding has been reported or is imminent. Necessary precautions should be taken at once.
Flood Advisory	Flooding of small streams, streets, and low-lying areas, such as railroad underpasses and urban storm drains, is occurring.

The threat of flooding is more likely in the spring, when late winter or spring rains, coupled with melting snow, fill river basins with too much water too quickly. Spring also represents the onset of severe weather in the form of thunderstorms, tornadoes, and heavy rains, which can generate flash flooding along these storm fronts. However, as demonstrated by the disaster declarations in December 1982 and the Great Summer Flood of 1993, severe flooding can occur in Missouri at any time of the year. Based on this information, the State rates the probability and severity of floods as high.

V. IMPACT OF THE HAZARD

The Federal Emergency Management Agency estimates that more than 216,000 households are within designated floodplains in Missouri. In addition, thousands of other Missouri residents are at risk to the dangers of flash flooding from rapidly rising creeks and tributaries, storm water runoff, and other similar flooding events. Nationwide, most flood deaths are from flash floods, and nearly half of these fatalities are auto related, according to the National Weather Service.

Of the 49 deaths recorded during the floods of 1993, 35 (71 percent) were from flash floods. In that same category, 20 deaths (77 percent) were related to motor vehicles caught in flash floods. Missouri's river flooding in 1993 claimed 14 lives, with 6 deaths (23 percent) attributed to motor vehicles. (See flood-related mortality charts and maps in Section VII.)

Missouri flood disasters have inflicted tremendous loss in terms of damage to personal property, businesses, infrastructure/public property, and agriculture. Total losses during the 1993 flood disasters were estimated at approximately $3 billion. In addition, agricultural losses were estimated at $1.8 billion, as 3.1 million acres of farmland were either damaged or went unplanted because of the 1993 rains. The Department of Agriculture estimated that 445,000 acres of Missouri River bottomland were destroyed by washouts and sand scouring. While levees designed to protect up to 50-year floods did their jobs, the

amount of rain and up-river flooding took their toll. Of the 1,456 public and private levees in the state, approximately 840 were damaged.

Almost every Missourian was at some time affected by the 1993 floods through inundation of roadways, airports, and drinking water and sewage treatment facilities, and by loss of income. The Missouri Department of Labor and Industrial Relations reported that $6.2 million was disbursed for disaster unemployment assistance for people who lost work due to flooding from July 1993 through March 1994.

The floods of 1993-94 pointed out that too many Missourians were living in a floodplain. To rebuild in the floodplains, those whose homes sustained substantial damage (50 percent or more) were required to elevate the structures above the base flood level to protect from future flood damage. Under Missouri's Community Buyout Program, more than $30 million in federal money was committed to moving Missourians voluntarily out of the floodplains through the acquisition of primary residential properties. As a result of those actions, it is estimated that state taxpayers will save more than $200 million in future flood disaster claims.

VI. SYNOPSIS

Flood events are often accompanied by other types of severe weather, including tornadoes, lightning, and severe thunderstorm activity. These storms also present a danger to life and property, often resulting in many injuries, and in some cases, fatalities. Floodwaters themselves often interact with hazardous materials. This has prompted the evacuation of many citizens near such materials stored in large containers that could break loose or puncture as a result of flood activity. Such events occurred during the 1993 flood, when approximately 11,000 St. Louis residents residing near flood-threatened propane tanks were evacuated on July 30. Evacuations were also ordered on July 31, when bulk propane tanks were flooded by the River Des Peres in St. Louis County. Federal and state agencies retrieved more than 247 large storage tanks; 1,178 small tanks; 3,470 large drums (over 15 gallons); and 5,731 small drums that had been swept away by the floods.

Public health concerns that may result from flooding include the need for disease and injury surveillance, community sanitation to evaluate flood-affected food supplies, private water and sewage sanitation, and vector control (for mosquitoes and other entomology concerns).

VII. MAPS OR OTHER ATTACHMENTS

River Basin and Floodplain Maps are on file at the State Emergency Management Agency.

The following maps and tables depict additional Missouri flood information, generally from 1993 through 1999.

- Record High-Water Stages in Missouri During the Summer 1993 Flood: Table B-1
- Distribution of Levee Failures by Corps of Engineers District Number of Failed or Overtopped Levees, Summer 1993 Flood: Table B-2
- Causes of Death by Type of Flood, Summer/Fall 1993: Table B-3
- Spring 1993 Flood: Figure B-1
- Summer 1993 Flood: Figure B-2

- Fall 1993 Flood: Figure B-3
- Spring 1994 Flood: Figure B-4
- Spring 1995 Flood: Figure B-5
- July 1998 Flood: Figure B-6
- Fall 1998 Flood: Figure B-7
- Spring 1998 Flood and Storms: Figure B-8
- Spring 2000 Flood: Figure B-9
- Flood-Related Mortality, Missouri 1993: Figure B-10.

TABLE B-1

RECORD HIGH-WATER STAGES IN MISSOURI DURING THE SUMMER 1993 FLOOD (IN FEET)

River	1993 Level	Previous Record	Flood Stage
Mississippi River			
Hannibal	31.8	28.6	16
St. Louis	49.4	43.3	30
Cape Girardeau	48.0	45.6	32
Missouri River			
St. Joseph	32.7	26.8	
Kansas City	48.9	46.2	17
Jefferson City	38.6	34.2	32
Hermann	36.3	35.8	23
St. Charles	39.5	37.5	21

Source: U.S. Army Corps of Engineers (1993).

TABLE B-2

DISTRIBUTION OF LEVEE FAILURES BY CORPS OF ENGINEERS DISTRICT NUMBER OF FAILED OR OVERTOPPED LEVEES, SUMMER 1993 FLOOD

Corps of Engineers District	Federal Levees	Non-Federal Levees
St. Louis*	12 of 42	39 of 47
Kansas City**	6 of 48	810 of 810

Source: Natural Disaster Survey Report, "The Great Flood of '93."

Notes: The difference in the failure rates above is because most federal levees are designed to withstand a 100- to 500-year flood, while non-federal levees, predominantly protecting agricultural lands, are frequently designed for a flood with a return period of 50 years or less.

* Includes eastern Missouri and portions of Illinois.
** Includes northwestern, west-central, and portions of southwest Missouri, and areas in Kansas and Nebraska.

For information on specific river and stream gauge levels go to:

- Kansas City/Pleasant Hill: www.crh.noaa.gov/cgi-bin/ahps.cgi?eax.
- Springfield: www.crh.noaa.gov/cgi-bin/ahps.cgi?sgf
- St. Louis: www.crh.noaa.gov/cgi-bin/ahps.gfi?lsx.

TABLE B-3

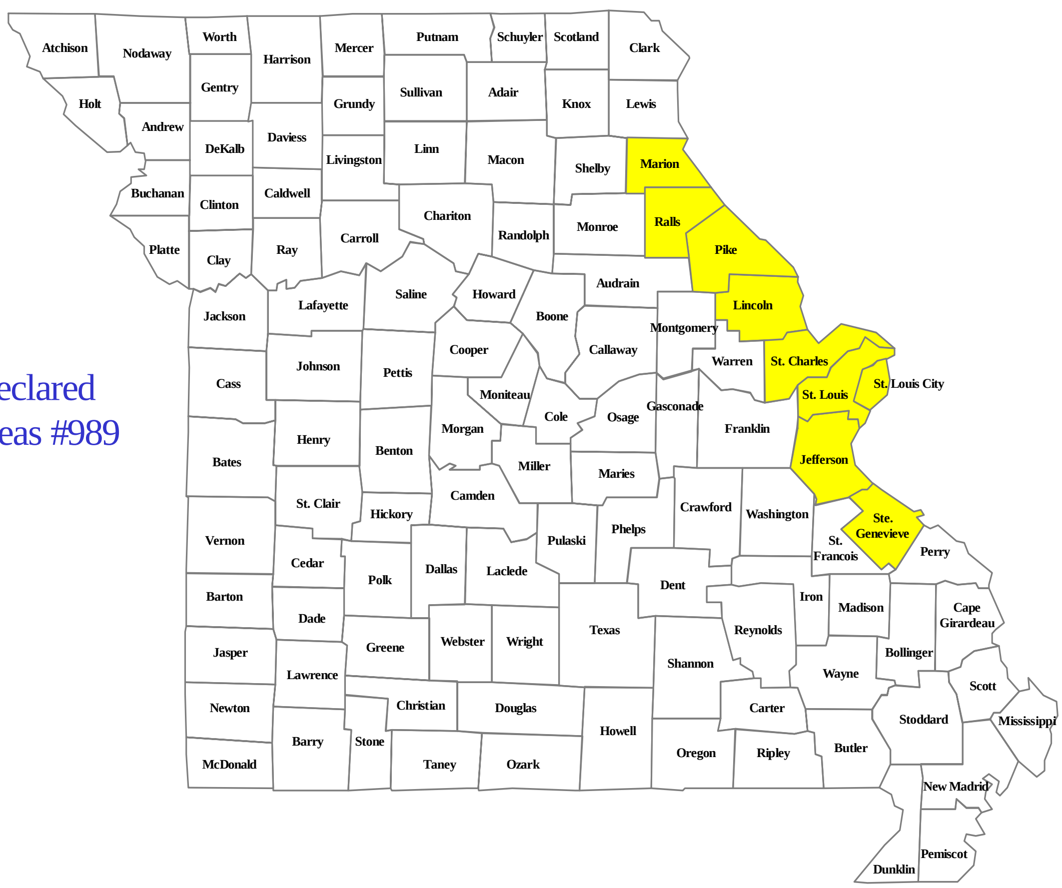
SUMMER/FALL 1993
CAUSES OF DEATH BY TYPE OF FLOOD

	River Flood	Flash Flood	Total
Motor Vehicle	6 (23%)	20 (77%)	26 (53%)
Drowning	5 (25%)	14 (74%)	19 (39%)
Electrocution	1 (50%)	1 (50%)	2 (4%)
Cardiac	2 (100%)	0	2 (4%)
All Causes	14 (29%)	35 (71%)	49 (100%)

FIGURE B-1

SPRING 1993 FLOOD

Counties Declared
Disaster Areas #989



IA Only

Individual Assistance Only - 8 Counties

FIGURE B-2

SUMMER 1993 FLOOD

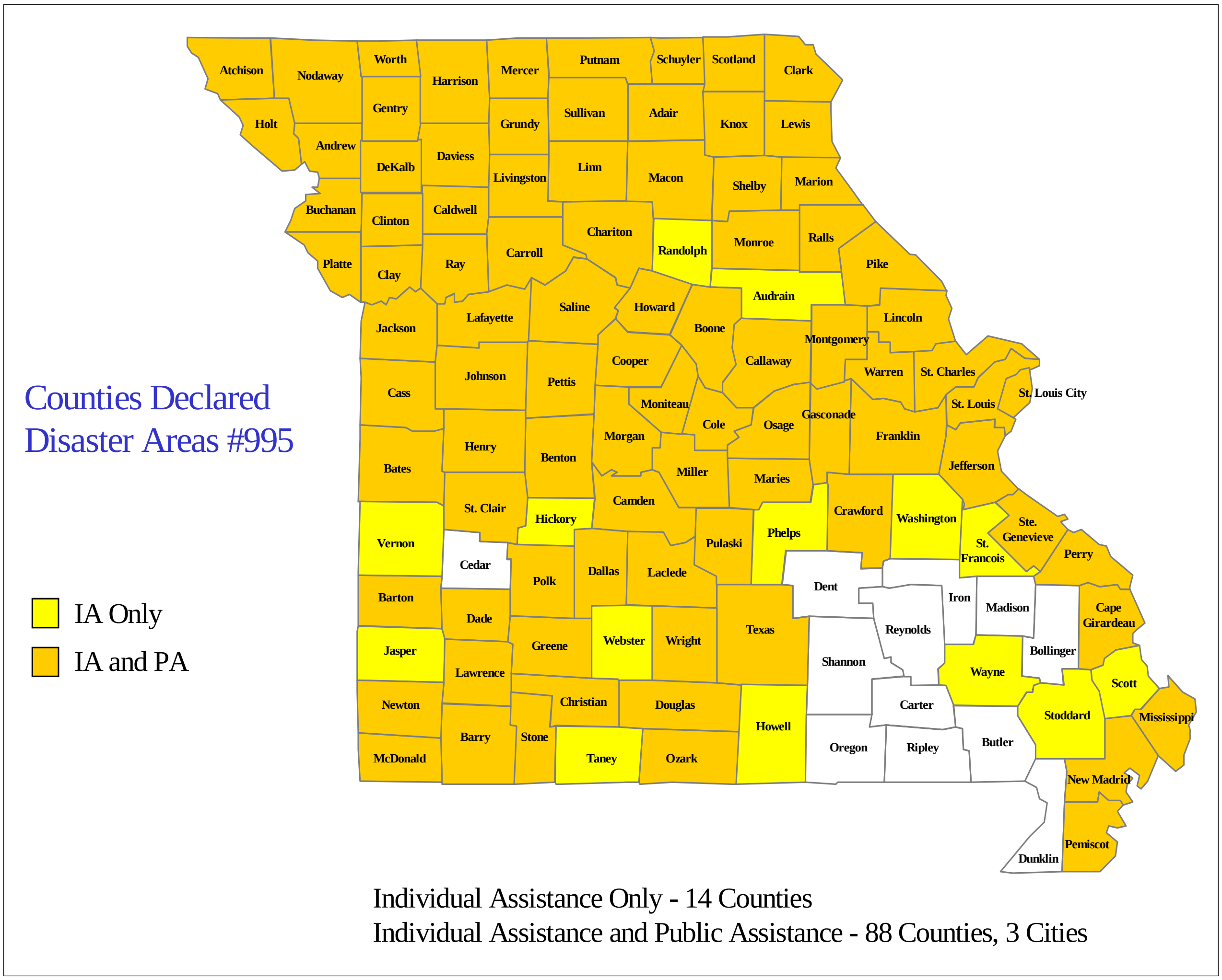


FIGURE B-3

FALL 1993 FLOOD

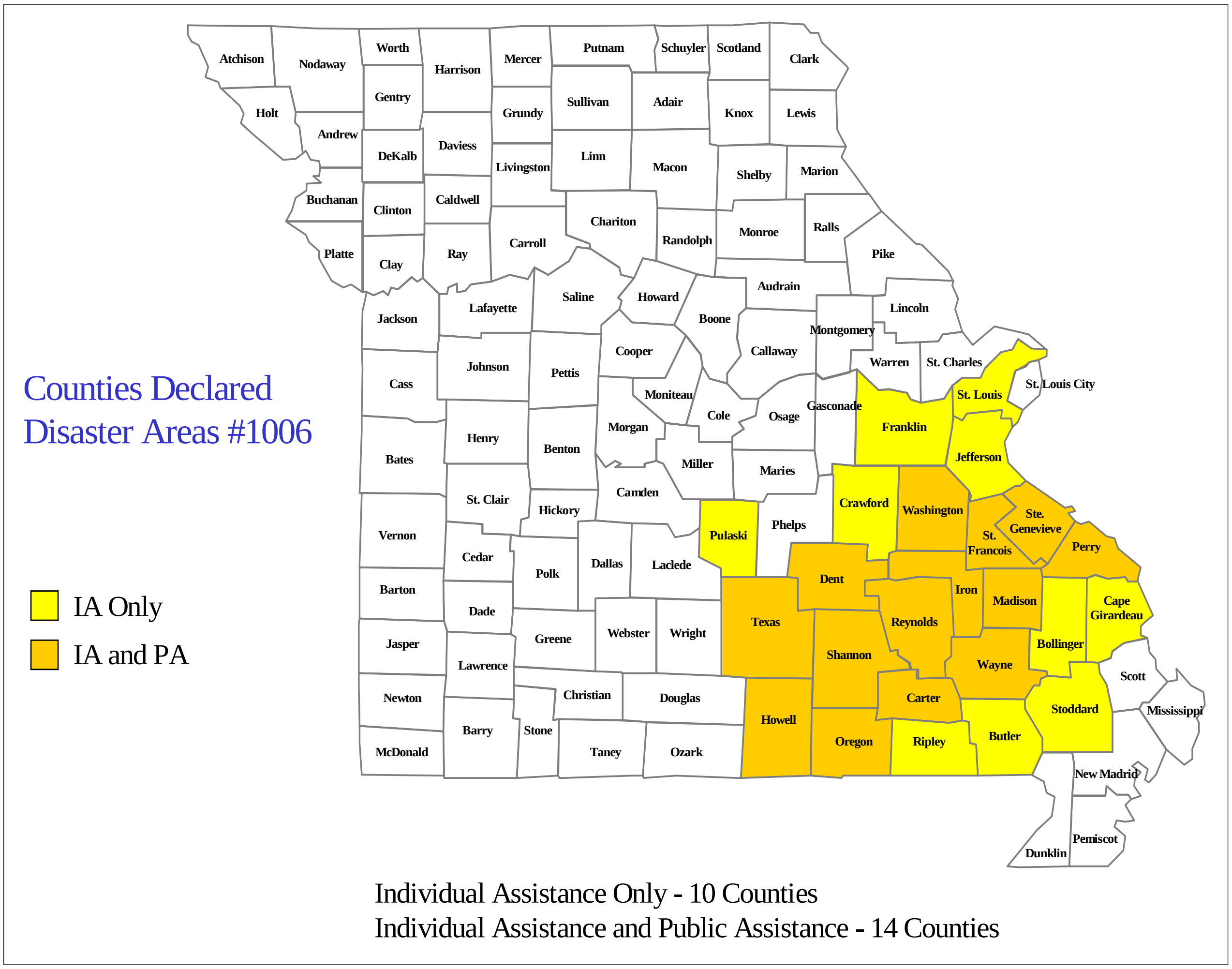
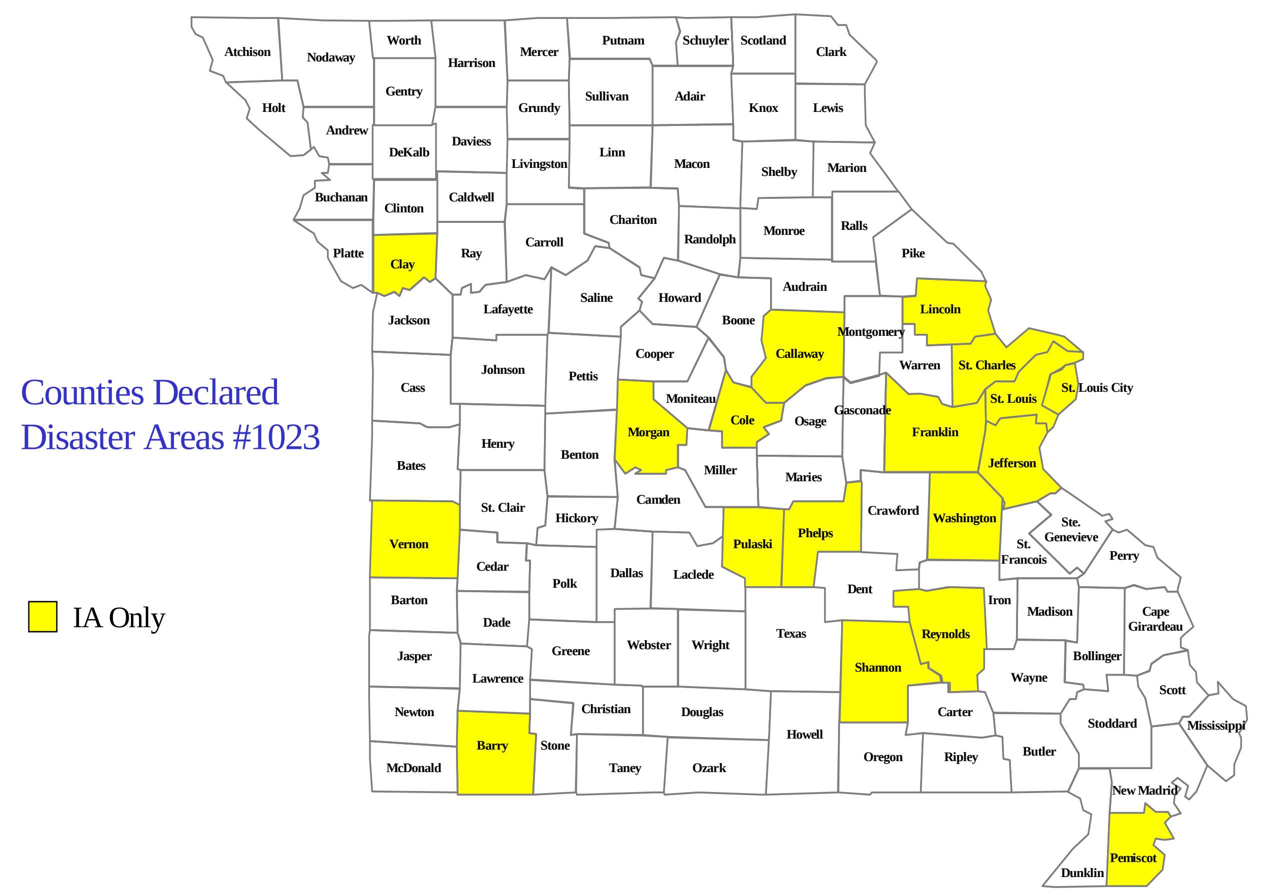


FIGURE B-4

SPRING 1994 FLOOD



Individual Assistance Only - 17 Counties, 1 City

FIGURE B-5

SPRING 1995 FLOOD

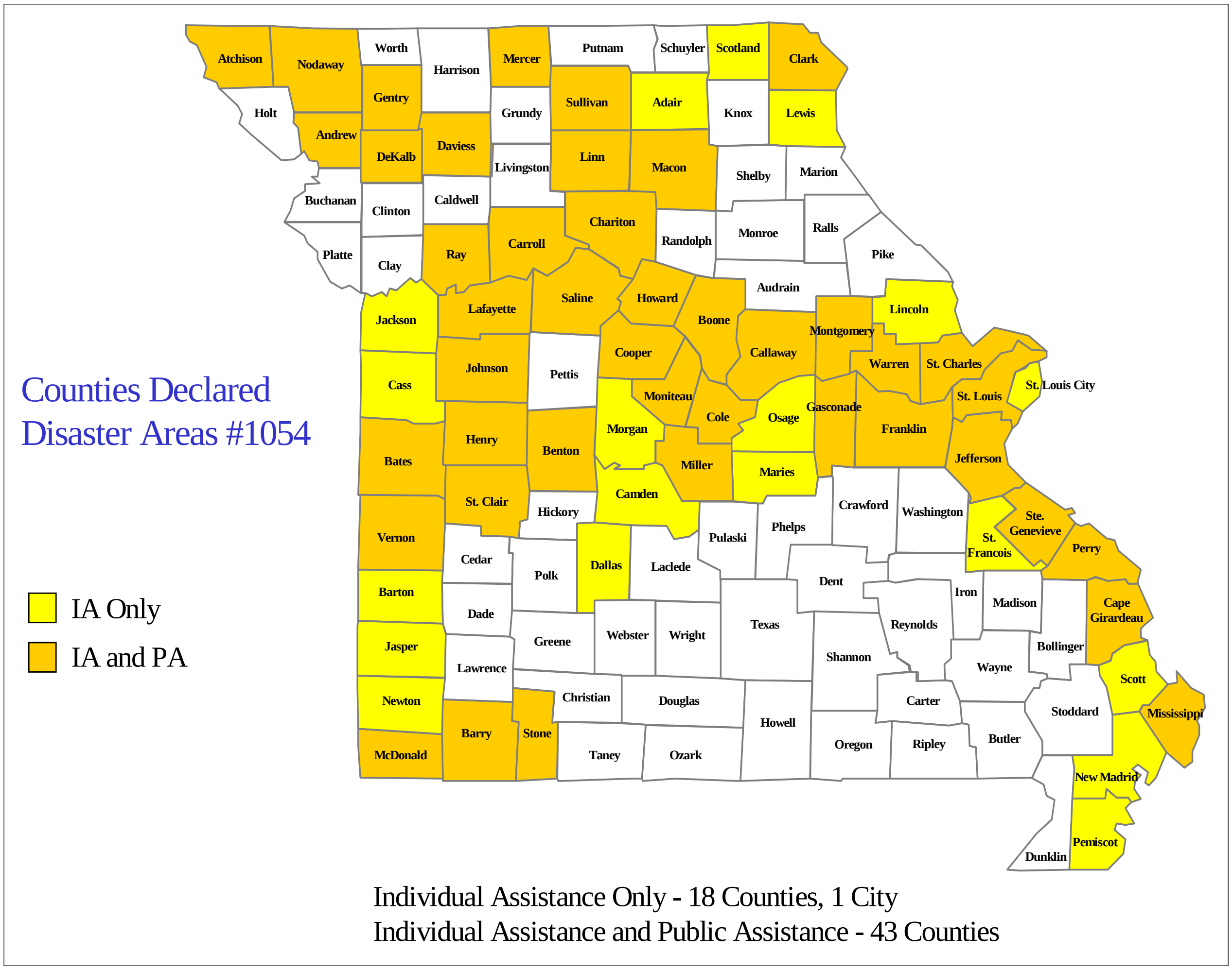
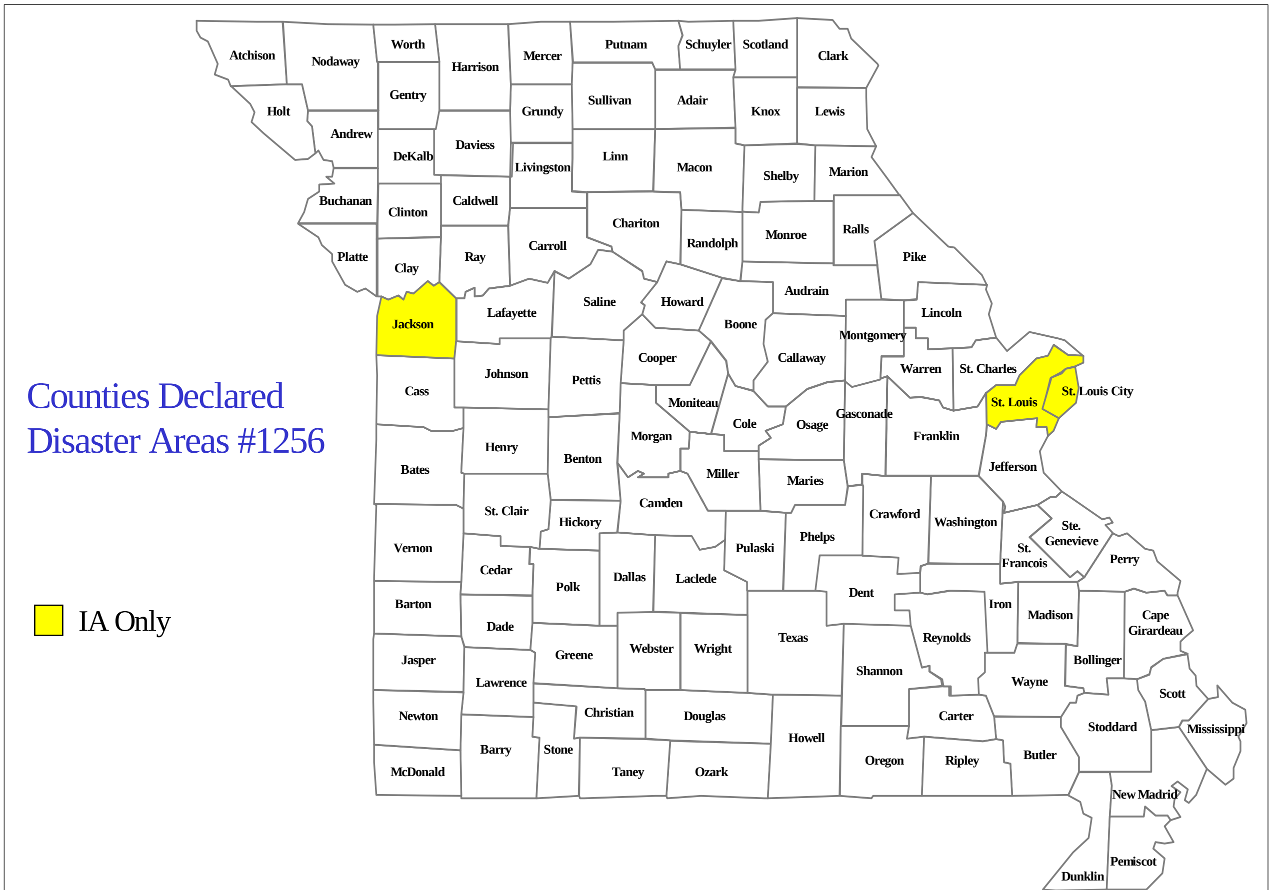


FIGURE B-6

JULY 1998 FLOOD



Individual Assistance Only - 2 Counties, 1 City

FIGURE B-7

FALL 1998 FLOOD

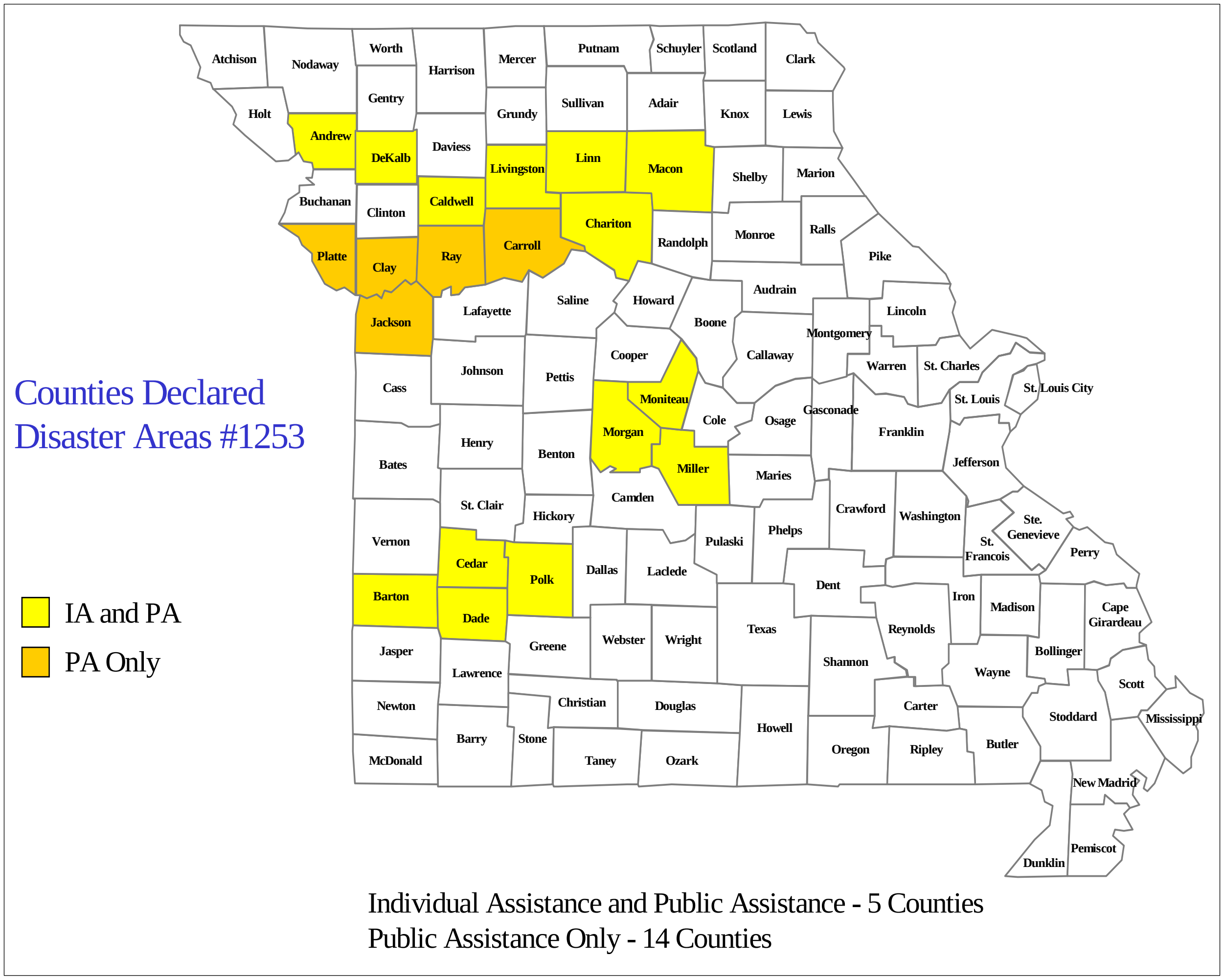
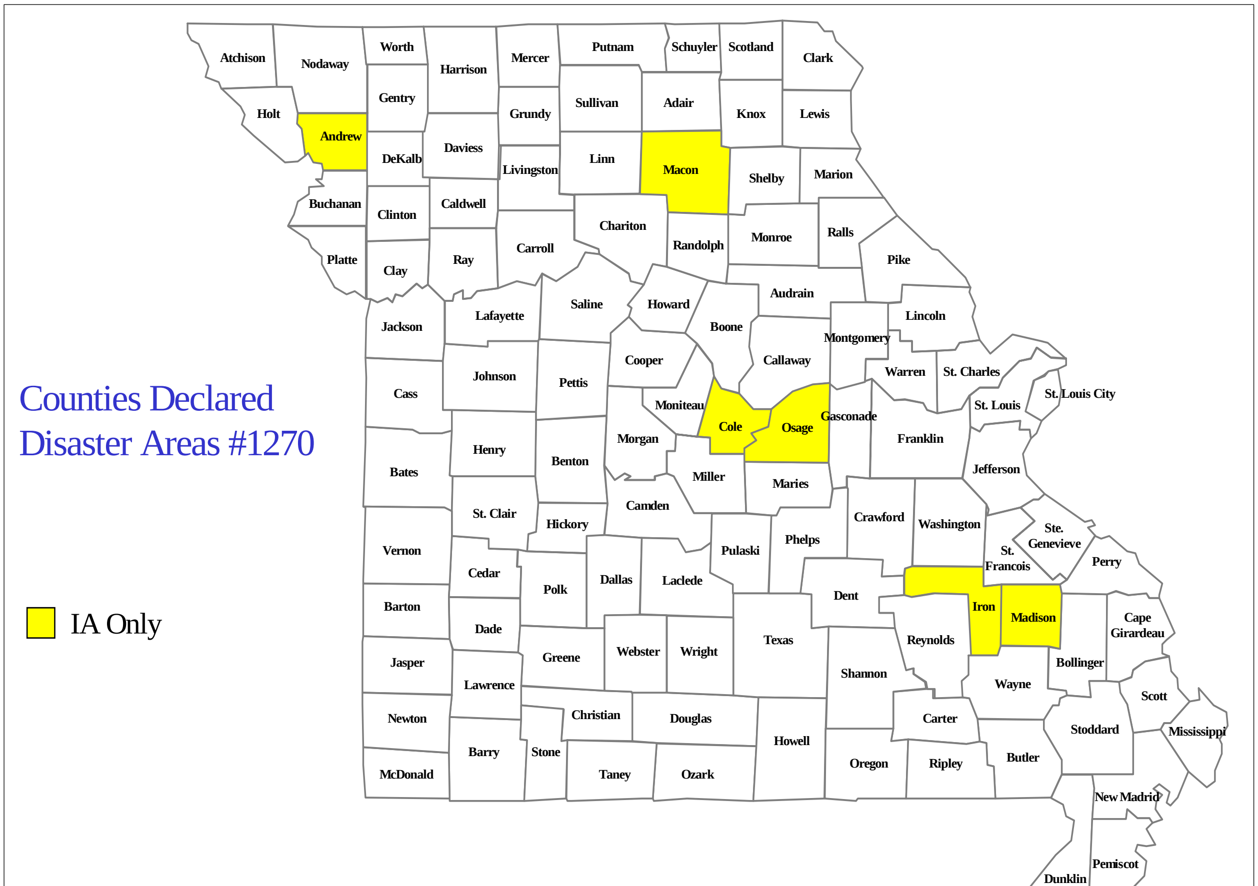


FIGURE B-8

SPRING 1998 FLOOD AND STORMS



Individual Assistance Only - 6 Counties

FIGURE B-9

SPRING 2000 FLOOD

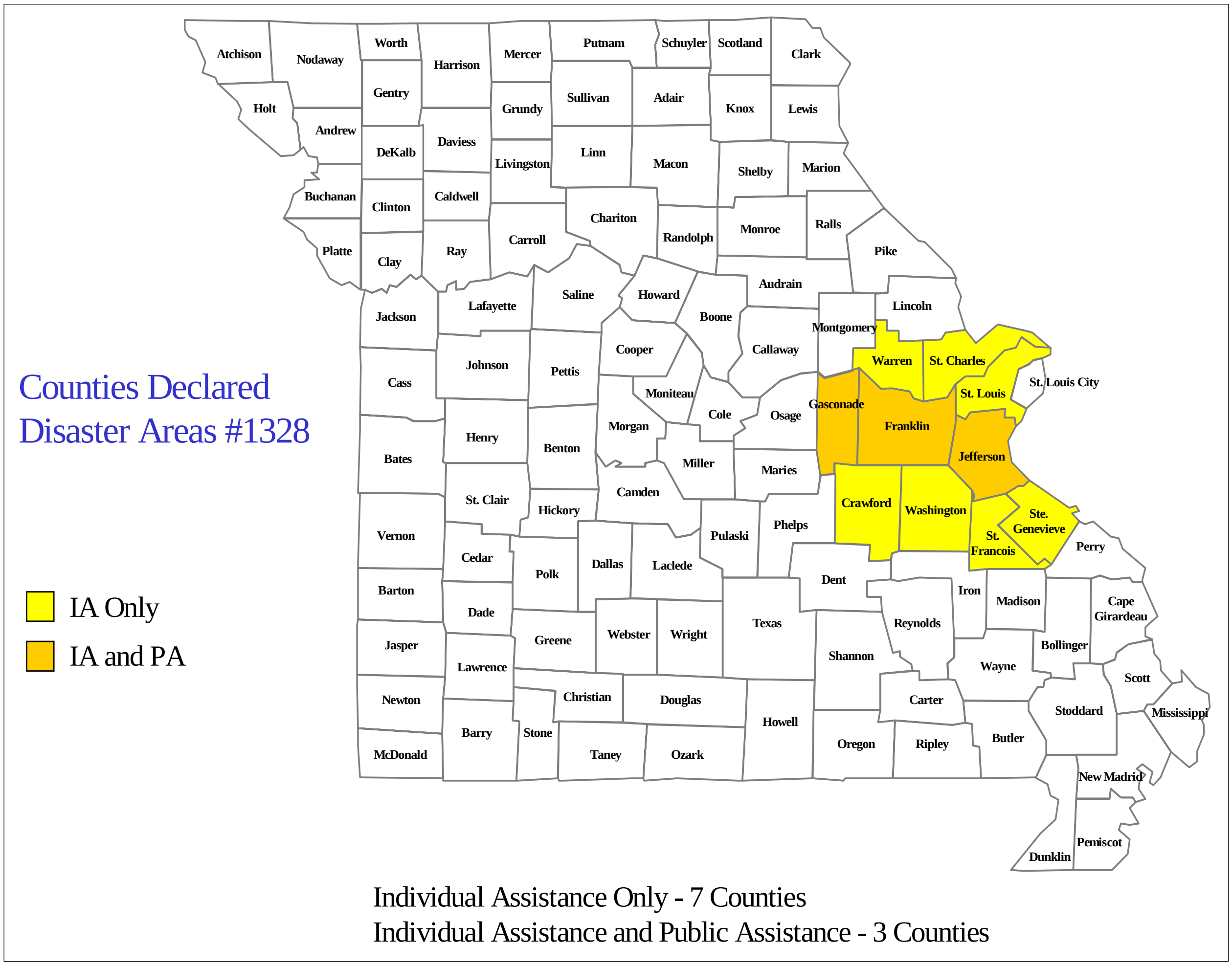
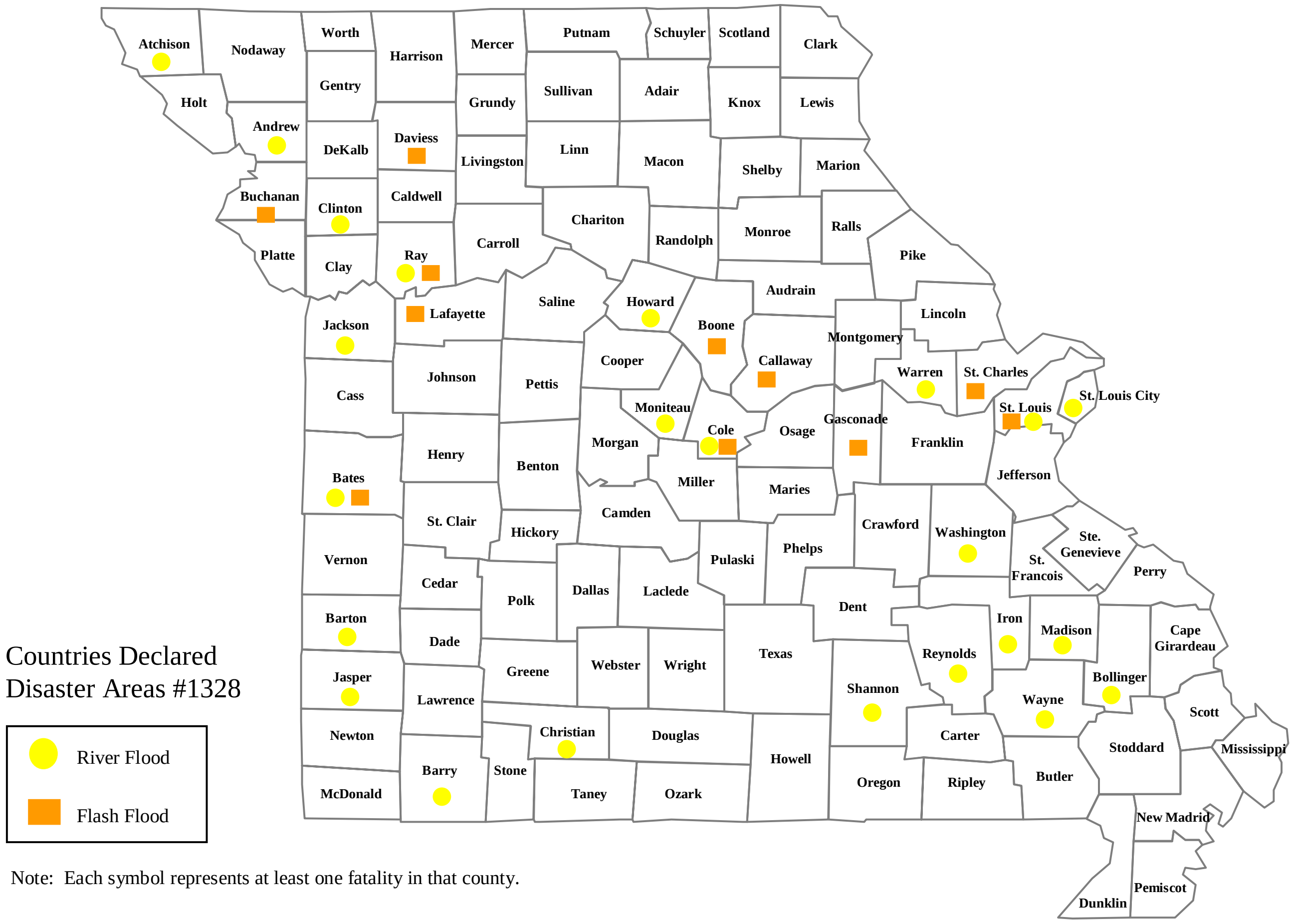


FIGURE B-10

FLOOD-RELATED MORTALITY
MISSOURI 1993



Note: Each symbol represents at least one fatality in that county.

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Illustrations:

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SEMA. "Maps – Spring, Summer, and Fall 1993 Floods, Spring 1994 Flood, Spring 1995 Flood, July 1998 Flood, Fall 1998 Flood, Spring 1999 Flood, Summer 2000 Flood (Counties/Cities Declared)".

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ANNEX C

SEVERE WINTER WEATHER
(SNOW, ICE, AND EXTREME COLD)

I. TYPE OF HAZARD

Severe Winter Weather (Snow, Ice, and Extreme Cold)

II. DESCRIPTION OF HAZARD

Severe winter weather, including snowstorms, ice storms, and extreme cold, can affect any area of Missouri. The greatest threat is likely to occur in the area north of the Missouri River, as with the devastating Kansas City area ice storm on January 31, 2002, which stretched into central Missouri and led to a Presidential Disaster Declaration. Severe weather, such as snow, ice storms, and extreme cold can cause injuries, deaths, and property damage in a variety of ways. Winter storms are considered deceptive killers. This is because most deaths are indirectly related to the storm. Causes of death range from traffic accidents due to adverse driving conditions such as icy roads, to heart attacks caused by overexertion while shoveling snow and from other related activities. Hypothermia or frostbite may be considered the most direct cause of death and injury that can be attributed to winter storms or severe cold. Economic costs are also difficult to measure. Heavy accumulations of ice can bring down trees, electric power lines and poles, telephone lines, and communications towers. Such power outages create an increased risk of fire, as home occupants use alternative fuel sources (wood, kerosene, etc. for heat, and fuel-burning lanterns or candles for emergency lighting). These storms can also affect utility and city operations due to debris removal and landfill hauling. In the 2002 ice storm, one home burned when ice-laden tree limbs fell and tore the electrical junction box from the outside of the home. Electrical sparks ignited a blaze that destroyed the home. Crops and trees can be damaged, and livestock can be killed or injured due to deep snow, ice, or severe cold. Buildings and automobiles may be damaged from falling tree limbs, power lines, and poles. Local governments, home and business owners, and power companies were faced with spending millions of dollars to restore services, remove debris, and haul debris. Federal public assistance for local governments and individual assistance for citizens and businesses under Presidential Disaster Declaration MO-DR 1403 helped cover much of the expense. (See storm synopsis under Section III, Historical Statistics.)

The types of watches and warnings during severe winter weather are listed below:

Winter Weather Advisory	Winter weather conditions are expected to cause significant inconveniences and may be hazardous. If caution is exercised, these situations should not become life threatening. Often the greatest hazard is to motorists.
Winter Storm Watch	Severe winter conditions, such as heavy snow and/or ice are possible within the next day or two.
Winter Storm Warning	Severe winter conditions have begun or are about to begin.
Blizzard Warning	Snow and strong winds will combine to produce a blinding snow (near zero visibility), deep drifts, and life-threatening wind chill.

III. HISTORICAL STATISTICS

Weather data indicate that the Missouri counties north of the Missouri River receive an average annual snowfall of 18 to 22 inches. Counties south of the Missouri River receive an annual average of 8 to 12 inches. The events that involve borderline conditions of freezing rain and ice are highly unpredictable. The durations of the more serious events combined with other factors, such as high winds, are also highly unpredictable. The degree of severity may be localized to a small area due to a combination of climatic conditions.

Besides snow and ice, extremely cold temperatures can produce problems. The wind chill is determined by factoring cold temperatures and wind speed (see Table C-1). For example, when the temperature is 20 °F and the wind speed is 15 mph, the resulting wind chill (what it really feels like) is 6 °F. This type of situation can be dangerous to people outdoors because their bodies can experience rapid heat loss and resulting in hypothermia (abnormally low body temperature). Statistical information regarding hypothermia mortality is provided on Figure 2 at the end of this annex.

An indirect winter hazard that affects Missourians every year is carbon monoxide poisoning. Improperly vented gas and kerosene heaters or the indoor use of charcoal briquettes creates dangerous levels of carbon monoxide. In 1997, 31 cases of carbon monoxide poisoning were reported in Missouri. No deaths were reported from these cases.

The following summaries describe some of the more significant severe winter weather events occurring in Missouri in recent years. (This information was taken from the National Weather Service's "Storm Data and Unusual Weather Phenomena" publication.)

February 15-16, 1993: Central and southern Missouri was covered with up to 21 inches of snow. The airport at Cape Girardeau received 6 inches of snow in 1 hour and 20 minutes.

January 14-20, 1994: Northeast, central, and east-central Missouri experienced overnight low temperatures from below zero to –20 °F. Hundreds of homes and businesses had frozen and busted water pipes. Wind chills, which ranged from -30 to -50 °F, kept schools closed and accounted for 15 people being admitted to local hospitals for hypothermia and frostbite.

January 16-17, 1994: A layer of ice up to 2 inches thick formed over sections of southeast Missouri, followed by 6 to 10 inches of snow. Some areas were without power for more than 24 hours. Roofs collapsed due to the heavy weight of snow and ice.

December 6, 1994: Ice accumulations of 0.5 to 1.0 inch were reported across northwest, north-central, and northeast Missouri. Over 75 percent of the residents in this region were without power. Phone and cable television was also out. A few rural areas were without power for at least seven days. The City of St. Joseph was declared a disaster area by Governor Mel Carnahan because of damages totaling nearly $4 million.

January 18-19, 1995: Central Missouri received heavy snows, dumping 19.7 inches over Columbia alone and setting a new 24-hour snowfall record. Parts of I-70, I-44, and other major highways were closed due to drifting snow. Snow fell at such a fast rate that snowplows and graders became stuck. Almost 5,000 birds were killed when several large chicken and turkey barns collapsed. Thousands of people were without power and telephone service. The Jefferson City and Columbia airports were closed for a time. The University of Missouri at Columbia canceled classes for the first time in nearly 17 years. State offices in Jefferson City were also closed.

October 22-23, 1996: An early snowfall hit the Kansas City area, dumping as much as 8.5 inches of heavy wet snow. Approximately 130,000 residences were without power, and an estimated $1.5 million in property damages were reported.

January 10-13, 1997: Northwest and west-central Missouri experienced overnight low temperatures below zero. No record low temperatures were recorded, but winds gusting up to 30 mph produced afternoon wind chills as low as -30 to -50 °F.

April 10-11, 1997: A spring snowstorm dumped up to 24 inches in extreme north Missouri. Schuyler County alone reported $2 million in damages, most due to the heavy snow causing roofs on farm buildings to collapse.

January 31, 2002: A massive severe winter storm system dumped snow and ice from Oklahoma to Kansas and into central and northern Missouri. In Missouri alone, more than 600,000 residents were without power, as ice-encased power lines snapped in fierce winds or were pulled down by falling trees and limbs. Loss of electricity included more than 460,000 people in the Kansas City metro area alone (Jackson, Cass, Clay, and Platte counties). Additionally, residents in a line from Kansas City to the Iowa-Illinois border were without power as rural electric cooperative lines broke as well. Outages ranged from several days to nearly two weeks. Damage to property, power restoration, and the cost of debris removal for local governments was so high that Missouri received a Presidential Disaster Declaration (MO-DR 1403) on February 6, 2002, which ultimately included 43 counties; 26 were designated for both individual and public assistance, and 17 were eligible for individual assistance only. (For a list of all counties declared, see Figure 1 in Section VII.) The total eligible public assistance costs for this disaster ($61.9 million dollars as of August 2002) ranks the 2002 ice storm as Missouri's second most costly disaster to date.

IV. MEASURE OF PROBABILITY AND SEVERITY

It is quite difficult to make an objective and quantitative measure of the probability and severity of snowstorms, ice storms, and extreme cold. Therefore, any analysis should be considered subjective and qualitative.

For areas north of the Missouri River, the probability of a snowstorm, ice storm, or extreme cold should be considered high due to historically higher average snowfall and lower average temperatures. However, the severity is rated moderate due to the overall level of preparedness in this area. For example, homes and businesses may be better insulated due to the higher probability of severe cold relative to other areas. Also, people living in this area may be more likely to use snow tires or purchase four-wheel-drive vehicles. People living in this area may be more likely to maintain adequate supplies of home heating fuels and consider other preparedness measures. Local and state governments may have access to more snow clearing equipment and maintain adequate supplies of materials needed for snow or ice removal. School districts and businesses may be more likely to develop and use snow routes or establish closing procedures.

Areas south of the Missouri River have a low probability of a snowstorm, ice storm, or extreme cold due to their lower average snowfalls and temperatures. However, such events in these areas have a moderate potential severity. This may be due to a lower level of preparedness. People living in this area may have homes with inadequate insulation or fail to maintain an adequate supply of home heating fuels. People may be less likely to equip their vehicles with snow tires or purchase four-wheel-drive vehicles. Local and state governments may not maintain sufficient amounts of equipment and materials. Schools and businesses may not have formal snow routes or closing procedures.

V. IMPACT OF THE HAZARD

People are adversely affected by winter storms, ice storms, and extreme cold, some more than others. Observations by the National Oceanic and Atmospheric Administration (NOAA) indicate that of winter deaths related to exposure to cold, 50 percent were over 60 years old, over 75 percent were male, and about 20 percent occurred in the home. Of winter deaths related to ice and snow, about 70 percent occur in automobiles, and 25 percent are people caught in storms. As noted earlier, ice storms can result in significant economic costs to homeowners, business owners, and utility companies. The ice storm in December 1994 demonstrated the environmental damage that can occur. Thousands of trees and plants were cut down or damaged as a result of the ice storm. The problem of debris clearance caused environmental impacts due to the permitted burning of debris or reduced landfill space.

VI. SYNOPSIS

As noted in this report, snowstorms, ice storms, and extreme cold can interact to cause many hazards. Only a few degrees may be the difference between rain, ice, or snow. Duration and intensity of any of these events will determine the overall impact of a particular event. Wind speed may be the difference between a minor snow or a blizzard. These events cannot be prevented. Preparedness for these events may be the greatest single factor to reduce loss of life, injury, and property damage. NOAA weather broadcasts via radio and television provide important information for people to prepare and thus reduce risks to their lives and property.

VII. MAPS OR OTHER ATTACHMENTS

(MO-DR 1403): Counties declared for individual assistance and public assistance from the January 2002 ice storm are shown on Figure C-1.

Hypothermia: Hypothermia is defined as a cold injury associated with a fall of body temperature to less than 94.1ºF, which results from unintentional exposure to a cold environment. In Missouri, 371 people have died from the cold during the winter months since 1979 when data collection of hypothermia first began in Missouri. There were 28 deaths during the 2002-2003 cold weather season and 20 deaths during the 2003-2004 season (preliminary data).

The elderly are more likely to be victims of cold-related illness resulting in death. Too often handicapped or elderly individuals fall outside their homes and are unable to reach shelter or help. During the cold weather seasons 1989-2004 (preliminary data), 110 (51%) hypothermia deaths were of people age 65 years and older. Deaths of individuals between the ages of 25-64 often have a contributing cause of substance abuse or a debilitating medical condition. Since 1989, there have been 97 (45%) hypothermia deaths in this population. Fortunately, deaths in people age <25 years are rare, accounting for only 7 (3%) of the total 214 Missouri hypothermia deaths for the 1989-2004 (preliminary data).

From cold weather winter seasons 2000 through 2004 (preliminary data), the largest number of deaths were among white males comprising 48% (n=39) of the 81 total cold related deaths. The majority, 46 (57%), of deaths occurred in the non-metropolitan areas of Missouri. Jackson County had 18 (22%) deaths, St. Louis County had 9 (11%), and St. Louis City had 8 (10%) of the total 81 hypothermia deaths since 2000.

New Wind Chill Chart: In 2001, the National Weather Service implemented a replacement Wind Chill Temperature (WCT) index for the 2001-2002 winter season (see Table C-1). The reason for the change was to improve the current WCT index used by the NWS and the Meteorological Services of Canada (MCS, the Canadian equivalent of the NWS), which was based on scientific research and a previous index from 1945.

The new formula makes use of advances in science, technology, and computer modeling to provide a more accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures. In addition, clinical trials have been conducted, and the results of those trials have been used to verify and improve the accuracy of the new formula. The new WTC index incorporates the following factors:

- Uses wind speed calculated at the average height (5 feet) of the human body's face, instead of 33 feet (the standard anemometer height)
- Is based on a human face model
- Incorporates modern heat transfer theory (heat loss from the body to its surroundings during cold and breezy/windy days)
- Lowers the calm wind threshold to 3 mph
- Uses a consistent standard for skin tissue resistance
- Assumes the worst-case scenario for solar radiation (clear night sky).

FIGURE C-1

DR-1403 Presidential Declaration

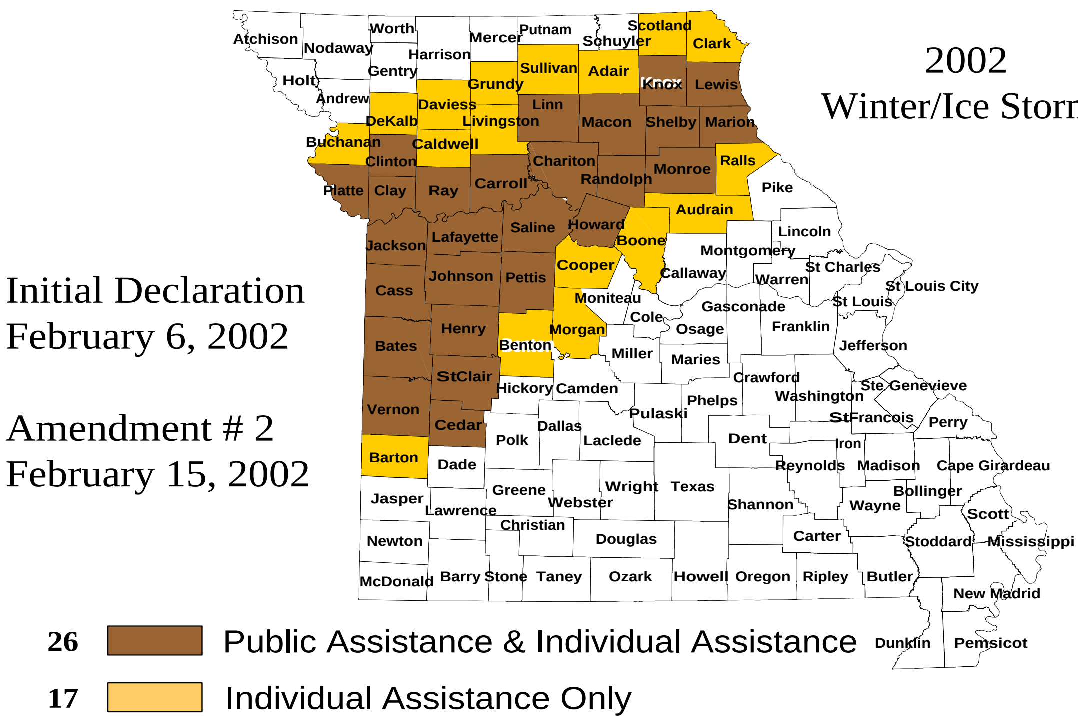
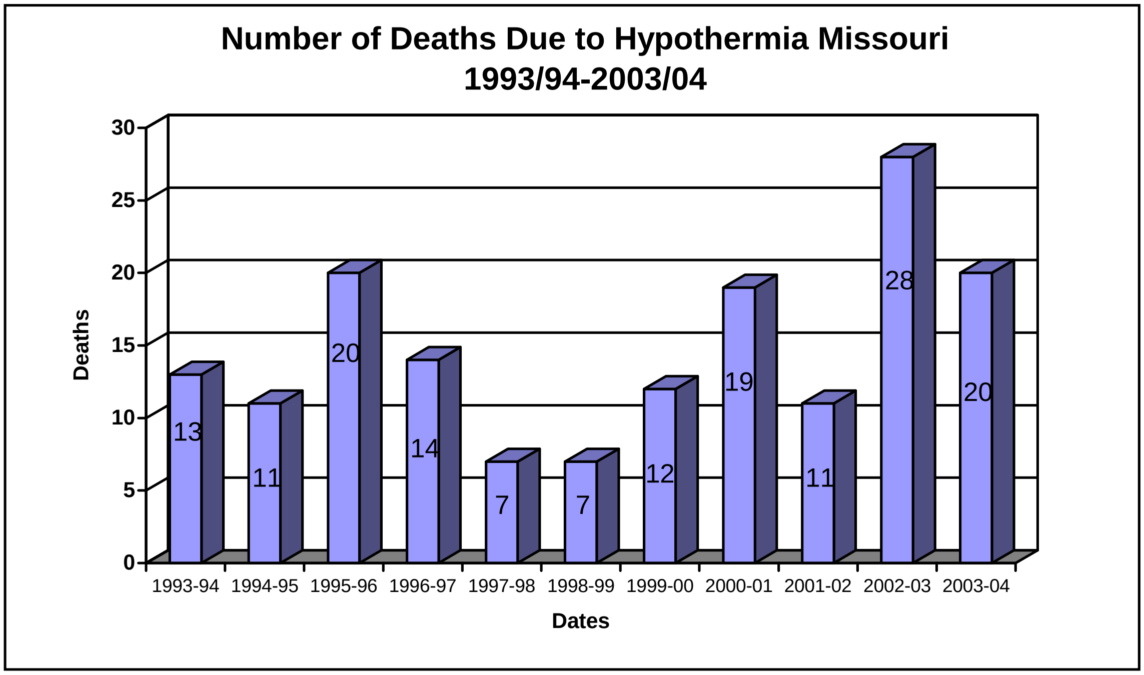


FIGURE C-2



Source: Missouri Department of Health and Senior Services

TABLE C-1

Wind Chill Chart

Wind (mph) \ Temperature (°F): Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T = Air Temperature (°F) V = Wind Speed (mph)

Effective 11/01/01

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ANNEX D

DROUGHT

I. TYPE OF HAZARD

Drought

II. DESCRIPTION OF HAZARD

Drought is not a hazard that affects just farmers, but can impact the nation's entire economy. Its outcome can adversely affect a small town's water supply, homeowners, the corner grocery store, commodity markets, and tourism. According to the National Drought Mitigation Center, drought costs the U.S. economy about $7 to 9 billion dollars a year. Losses from the 1988-1989 droughts were projected by Chamgnon and Riebsame and White House Study Group at $39.2 billion for 1988, including about $51.6 billion in agricultural losses. The University of Missouri estimated the drought losses of 2002 and 2003 farm production years. Economic impact to the Missouri economy due to agricultural losses were $461 million for 2002 and $575 million in 2003.

The dictionary defines drought as a period of prolonged dryness. The Missouri Drought Response Plan distinguishes between five "categories" of drought, as follows:

1. **Agricultural Drought**, defined by soil moisture deficiencies
2. **Hydrological Drought**, defined by declining surface and groundwater supplies
3. **Meteorological Drought**, defined by precipitation deficiencies
4. **Hydrological Drought & Land Use,** defined as a meteorological drought in one area that has hydrological impacts in another area
5. **Socioeconomic Drought,** defined as drought that impacts supply and demand of some economic commodity.

Each of these definitions relates the occurrence of drought to water shortfall in some component of the hydrological cycle. Each affects patterns of water and land use, and each refers to a repetitive climatic condition. In urban areas, drought can affect those communities that depend on reservoirs for water, and decreased water levels due to insufficient rain can lead to restricted water use. In agricultural areas, drought during the planting and growing season can have a significant impact on yield.

The U.S. Government's definition of an agricultural drought incorporates specific parameters based on historical records. Agricultural drought is "a combination of temperature and precipitation over a period of several months leading to a substantial reduction in yield (bushels per acre) of one or more of the three major food grains (wheat, soybean, corn). A substantial reduction is defined as a yield (bushels per acre) less than 90% of the yield expected with temperature/precipitation equal to long term average values."

Regardless of the specific definition, droughts are difficult to predict or forecast, both as to when they will occur and how long they will last. According to Dr. Grant Darkow, Department of Atmospheric Science, University of Missouri-Columbia, there is a recognizable "upper air-flow pattern and simultaneous

surface pattern associated with abnormal dryness over Missouri." When the upper air-flow pattern is typified by air flowing in a broad arc over the central plains with higher speeds in southern Canada than over the U.S., then the air over the southern plains will be "characterized by a weak clockwise circulation." Storm systems coming off the Pacific Ocean will cross the extreme northwestern states and southern Canada, thus bypassing the midwestern states. When this flow pattern persists, the result can be a prolonged period of drought.

The most commonly used indicator of drought and drought severity is the Palmer Drought Severity Index (PDSI), which is published jointly by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Department of Agriculture (USDA) (see Table D-1). The PDSI measures the difference between water supply (in terms of precipitation and stored soil moisture) and demand (the amount of water required to recharge soil and keep rivers, lakes and reservoirs at normal levels). The result is a scale from +4 to -4, at 1.0 and 0.5 intervals. By relating the PDSI to a regional index, one can compile data that reflects long-term wet or dry tendencies.

TABLE D-1

PALMER DROUGHT SEVERITY INDEX (PDSI)

PDSI Number	Long-Term Tendency
Above 4.0	Extreme moist spell
3.0 to 3.9	Very moist spell
2.0 to 2.9	Unusually moist spell
1.0 to 1.9	Moist spell
0.5 to 0.9	Incipient moist spell
0.4 to -0.4	Near normal conditions
-0.5 to -0.9	Incipient drought
-1.0 to -.9	Mild drought
-2.0 to -2.9	Moderate drought
-3.0 to -3.9	Severe drought
Below -4.0	Extreme drought

For PDSI reporting purposes, Missouri is divided into six regions of similar climatic conditions: Northwest, Northeast, West Central, Southwest, Southeast, and Bootheel. These regions are illustrated on Figure D-1 (Palmer Drought Severity Index, Missouri Subregions) in Section VII of this annex.

In addition to the NOAA/USDA indices, water management agencies in Missouri have access to the Missouri Crop and Weather Report, produced by the Missouri Agricultural Statistics Service. These reports provide detailed statistical information on weather conditions, crop conditions, topsoil moisture supply, and subsoil moisture supply by subregion throughout Missouri.

Other less quantitative indicators of drought include high water demand versus available supplies, reduced stream flows, declining reservoir levels, precipitation deficits, falling water levels in wells, and low soil moisture.

The difficulty with recognizing or predicting drought is that no single indicator can be reliably used to

predict onset. Regional indicators such as the PDSI are limited in that they respond slowly to deteriorating conditions, whereas observations of surface conditions and groundwater measurements or rainfall may only provide a "snapshot" of a very small area.

Consequently, the use of a variety of drought indicators is essential for effective assessment of drought conditions, and the PDSI is the primary means to assess drought severity.

Missouri's Drought Response System is divided into four phases:

1. **Phase I - Advisory Phase:** Requires a drought monitoring and assessment system to provide enough lead time for state and local planners to take appropriate action.

2. **Phase II - Drought Alert:** When the PDSI reads -1.0 to -2.0, and stream flows, reservoir levels, and groundwater levels are below normal over a several month period, or when the Drought Assessment Committee (DAC) determines that Phase II conditions exist based on other drought determination methods.

3. **Phase III - Conservation Phase:** When the PDSI reads -2.0 to -4.0, and stream flows, reservoir levels, and groundwater levels continue to decline, along with forecasts indicating an extended period of below-normal precipitation, or when the DAC determines that Phase III conditions exist based on other drought determination models.

4. **Phase IV - Drought Emergency:** When the PDSI is lower than -4.0, or when the DAC determines that Phase IV conditions exist based on other drought determination methods.

III. HISTORICAL STATISTICS

According to the 2004 revision of the Missouri Climatic Atlas for Design of Land Application Systems 9MDNR-WP-1400) Missouri's average annual rainfall ranges from about 33.6 inches in the northwest to about 51 inches in the southern tier of the Missouri bootheel. Even the driest areas of Missouri have more rainfall than most western states; however, lack of rainfall impacts certain parts of the state more than others because of alternate source availability and usage patterns.

Southern Missouri—Most of the southern portions of Missouri are less susceptible to problems caused by prolonged periods without rain because of abundant groundwater resources in the region. Even with decreased stream flows or lowered reservoir levels, groundwater is still a viable resource in southern Missouri. Row-crop farming is not extensive, and therefore agricultural needs aren't as great as in other parts of the state. The only exception is in the southwestern and southeastern areas where irrigation is used.

Northern And West Central Missouri—Most of the northern and west-central portions of Missouri are underlain by rocks that are not conducive to water-bearing formations. They yield only small amounts of water, even during periods of normal and above-normal rainfall. Under drought conditions, adequate amounts of water cannot be pumped from the rock formations of northern Missouri to supply even domestic needs. Most streams in northern Missouri do not receive appreciable groundwater recharge. During periods of drought, these streams are generally reduced to a series of pools, or may become completely dry. Streams and water impoundments are the only localized sources of water during droughts, and even these limited resources are at risk when the drought is prolonged. Agriculture in west-central and northern Missouri is usually the first to feel the effects of drought. Although row-cropping is more extensive in this part of the state, irrigation is generally not feasible except on the floodplains of

major rivers.

Drought of 1999-2000

Most of Missouri, along with other states, was in a drought condition during the last half of 1999. The dryness did not begin until July 1999, but rapidly developed into a widespread drought by September. At that time, Missouri was placed under a Phase I Drought Advisory level by the Department of Natural Resources (MDNR), and Governor Carnahan declared an Agricultural Emergency for the entire state. Agricultural reporting showed a 50 percent crop loss from the drought in 50 counties, with severe damage to pastures for livestock, corn crops, and Missouri's top cash crop–soybeans. On October 13, 1999, U.S. Agriculture Secretary Dan Glickman declared all Missouri counties agricultural disaster areas, making low-interest loans available to farmers in Missouri and contiguous states. The drought intensity increased through autumn and peaked at the end of November 1999. In fact, the five-month span between July and November became the second driest July-November period in Missouri since 1895, averaging only 9.38 inches of rain.

A wetter-than-normal winter diminished dry conditions in central and southern Missouri, but long-term moisture deficits continued to exist. At the same time, the remainder of the state (roughly north of the Missouri River) continued under drought conditions. Overall dry conditions returned through much of the state in March 2000, and costly wildfires and brush fires (70) erupted in many counties. By May, the entire state was under a Phase II Drought Alert level, and on May 23, Governor Carnahan announced activation of the Missouri Drought Assessment Committee (DAC), made up of state and federal agencies and chaired by Mr. Jeff Staake the MDNR Deputy Director. At a May 25, 2002, meeting, the DAC selected a subcommittee (guided by the Missouri Drought Response Plan) to determine the drought status of each county. In June, based on observations across the state and projections of future rainfall, the committee in June upgraded the drought status for 27 northern Missouri counties to Phase III, Conservation. This was based on concerns for water supplies and agricultural impacts. The City of Milan in Sullivan County was among the most severely affected in terms of water supplies. In June, a total of 80 Missouri counties remained under the Phase II Alert level, while seven counties in southeast Missouri (Butler, Dunklin, Mississippi, New Madrid, Pemscot, Scott and Stoddard) remained under Phase I Advisory conditions.

By mid-July 2000, some areas of northern Missouri benefited from additional rainfall, while drier conditions prevailed in other areas. At its July 12 meeting, the DAC revised its assessment, placing 30 counties under Phase III Conservation conditions, including 10 counties in the south-central area. The remaining 84 counties in the state were under Phase II Drought Alert conditions. This included seven counties in northern Missouri, which were downgraded from Phase III Conservation, and seven counties in Southeast Missouri, which were previously assessed as Phase I Advisory.

To ease the agricultural impact of the drought during the summer months, Governor Carnahan gained release of over 1 million acres from the Conservation Reserve Program (CRP) to provide farmers and ranchers in 21 counties an additional sources to cut hay for livestock feed. Also, livestock producers in 16 counties were released from CRP contracts to allow cattle grazing on certain idle lands.

Drought of 2002-2004

The drought of 2002 caused tremendous financial hardships to many Missouri crop and livestock producers. The financial impact of the drought on producers in turn impacted the local communities and the state in terms of reduced economic activity. This drought cost an estimated $46 million in 2002 and $575 million for 2003 in terms of Missouri's agricultural and economic productivity.

Drought conditions encompassed most of the northwestern quarter of Missouri. Severe drought conditions affected the northwest, west-central, and some portions of southwest Missouri, causing water conservation measures to be taken and restrictions to be imposed. For some areas, this was the second driest year since 1914; the only drier year was in 1988. This was the driest November – December period on record for northwestern and north-central Missouri in 2002. The drought continued through 2003 and 2004 with conditions improving in 2004. As of March 3, 2004, drought conditions still encompassed most of the northwestern quarter of Missouri with 18 counties designated as being in Phase 3- Conservation Phase. The drought conditions improved due to an increase in precipitation between March and June 2004. In June 2004, Missouri was considered drought free for the first time in three years.

Drought of 2005

The Drought of 2005, as in the previous drought of 2003-2004, caused tremendous hardships to many Missouri crop and livestock producers. According to the University of Missouri's Food and Agriculture Institute (FAPRI), the estimated losses to the corn and hay crops alone will likely top $370 million. For some Missouri farmers this will be a drier year than 1988. By late July, the drought conditions encompassed all but nine counties in the northwestern corner of the state. Severe drought conditions affected counties in the southwest through the northeast part of the state. Effective August 23, 2005 due to the Secretarial disaster designation. 114 Missouri counties and the City of St. Louis were designated as natural disasters for physical and/or production loss loan assistance from Farm Service Agency (FSA). The drought conditions began to improve by late August and into September.

Drought of 2006

The Drought of 2006 has had a tremendous agricultural impact on Missouri farmers. As of September 2006, FSA reported that 26 counties had requested Emergency Conservation Program (ECP) funds with 2 additional counties pending. The livestock industry is feeling severe effects from the current drought. Hay supplies are short and water supplies for livestock continue to decline. USDA reported that the new $50 million program for livestock producers, called the Livestock Assistance Grant Program, will provide this money in Section 32 to states in block grant form. The drought has also had an impact on local water supplies with several communities issuing mandatory conservation measures. The most recent Drought Condition Status Map (August 16, 2006) approved by the Drought Assessment Committee (DAC) indicates that only 10 counties in the southeastern portion of the state were free of drought.

IV. MEASURE OF PROBABILITY AND SEVERITY

Because of its geographical location and characteristic weather patterns, Missouri is vulnerable to drought conditions. Agricultural droughts are the most common on record, particularly those inflicting damage to corn crop yields. Throughout much of this century, these droughts have occurred with common regularity (on the average of once every 5 years), according to the Missouri Crop and Livestock Reporting Service.

Based on Midwest drought data, the Missouri Department of Natural Resources (MDNR), Water Resources Program produced a Missouri Drought Response Plan in 1995, with revisions in 2002. The plan's primary purpose is to address the need for state and local governments to coordinate advanced emergency planning, as during the drought of 1999-2000. The plan outlines proactive emergency and tactical measures designed to better prepare the state for drought. It also emphasizes the need for long-range strategic planning, which would address the bigger issue of drought impact avoidance. The plan notes that one of the major goals of drought mitigation is to prevent water shortages in the agricultural sector and public water systems.

In preparing the plan, divided the state into three regions, which are prioritized according to drought susceptibility. The regions are identified as having slight, moderate, and severe susceptibility to drought conditions. They are illustrated on Figure D-2 (Drought Susceptibility) in Section VII of this annex. Descriptions of drought susceptibility for the three regions are as follows:

Region A (mostly Southeast Missouri) has very little drought susceptibility. It is a region underlain by sands and gravel (alluvial deposits). Surface and groundwater resources are generally adequate for domestic, municipal, and agricultural needs.

Region B (Central, East-Central Missouri) has moderate drought susceptibility. Groundwater resources are adequate to meet domestic and municipal water needs, but due to required well depths, irrigation wells are very expensive. The topography generally is unsuitable for row-crop irrigation.

Region C (Northern, West-Central Missouri; St. Louis County) has severe drought vulnerability. Surface water sources usually become inadequate during extended drought. The groundwater resources are normally poor, and typically supply enough water only for domestic needs. Irrigation is generally not feasible. When irrigation is practical, groundwater withdrawal may affect other uses. Surface water sources are used to supplement irrigation supplied by groundwater sources.

The Missouri Drought Response Plan relies primarily upon the PDSI to indicate drought severity, and supports its findings directly with stream flow, reservoir-level, and groundwater-level measurements. Actions within the drought plan are triggered when the PDSI reaches certain levels. The DAC, chaired by the Director, or designee of the Department of Natural Resources, is activated in the Phase II Drought Advisory Stage. The DAC then activates the Impact Teams, which cover the topics of agriculture, natural resources and environmental recreation, water supplies, wastewater and health, social, economic, and post-drought evaluations. Areas that appear to be the most vulnerable to drought are the focus of future drought planning, management, and mitigation activities. Based on this information, the State rates the probability and severity of the drought hazard as moderate.

V. IMPACT OF THE HAZARD

A severe drought in the Southern Plains states from the fall of 1995 through the summer of 1996 resulted in more than $1 billion in costs and damages to agricultural regions. The states of Texas and Oklahoma were most severely affected. In the summer of 1993, a combination of drought and a heat wave across the southeast U.S. was responsible for about $1 billion in costs and damages. Among the most costly disasters, however, was the Great Drought of 1988-1989, which caused an estimated $39 billion in losses in the United States. As a comparison, the record floods of 1993 in the Midwest inflicted damage in the range of $12 to $16 billion. Although more subtle in terms of physical damage, the social and economic costs of drought are substantial.

Drought, as it affects the health and safety of Missouri citizens, is primarily a problem of rural water supply. With some exceptions, larger municipalities have not experienced major problems at levels that have caused impacts to some smaller communities. Most seriously affected are those supplied by small water structures. In its scope, a drought may be limited to a localized problem, or even a regional problem. Based on severity and duration, it may even become a statewide problem, at least in terms of overall impact, such as the commitment and shifting of resources and other response issues. Good water quality and a plentiful supply are two factors that we often take for granted. But when good water becomes a scarce commodity and people must compete for the available supply, the importance of these two factors increases dramatically. The State Water Resources Plan (RSMO 640.415), which is a

provision of the Water Resources Law enacted by the Missouri Legislature in 1989, requires MDNR to ensure that the quality and quantity of Missouri's water resources are maintained at the highest possible level to support present and future beneficial uses. The provision was established to provide for the development, maintenance, and periodic updating of a long-range comprehensive statewide plan for the use of surface water and groundwater. It includes existing and future requirements for drinking water supplies, agriculture, industry, recreation, and environmental protection, and related needs.

VI. SYNOPSIS

In addition to damage to crops, produce, livestock, and soil, and the resulting economic consequences, the arid conditions created by drought pose an increased risk of fire. The danger is especially high for brush fires, grass fires, and fires in wooded areas, which can threaten homes and other structures in their path. Lack of water resources in rural areas can complicate the firefighting efforts. During the spring 2000 drought, brush and wildfires erupted in numerous counties, resulting in a Governor's declared State of Emergency. The fires in Camden County were the most severe (See Fires, Annex I, in this State Hazard Analysis).

Severe drought also poses health threats to citizens due to water shortages and extreme heat. Particularly vulnerable are children, the elderly, and those with respiratory problems. Contaminated or poor water quality for drinking and sanitation measures can also cause serious illnesses. The Missouri Drought Response Plan addresses issues regarding water shortages and can be accessed via the MDNR website: www.MDNR.mo.state.mo.gov/.

VII. MAPS OR OTHER ATTACHMENTS

- Palmer Drought Severity Index: Figure D-1
- Drought Susceptibility: Figure D-2
- Drought Condition Status, July 29, 2005: Figure D-3.

FIGURE D-1

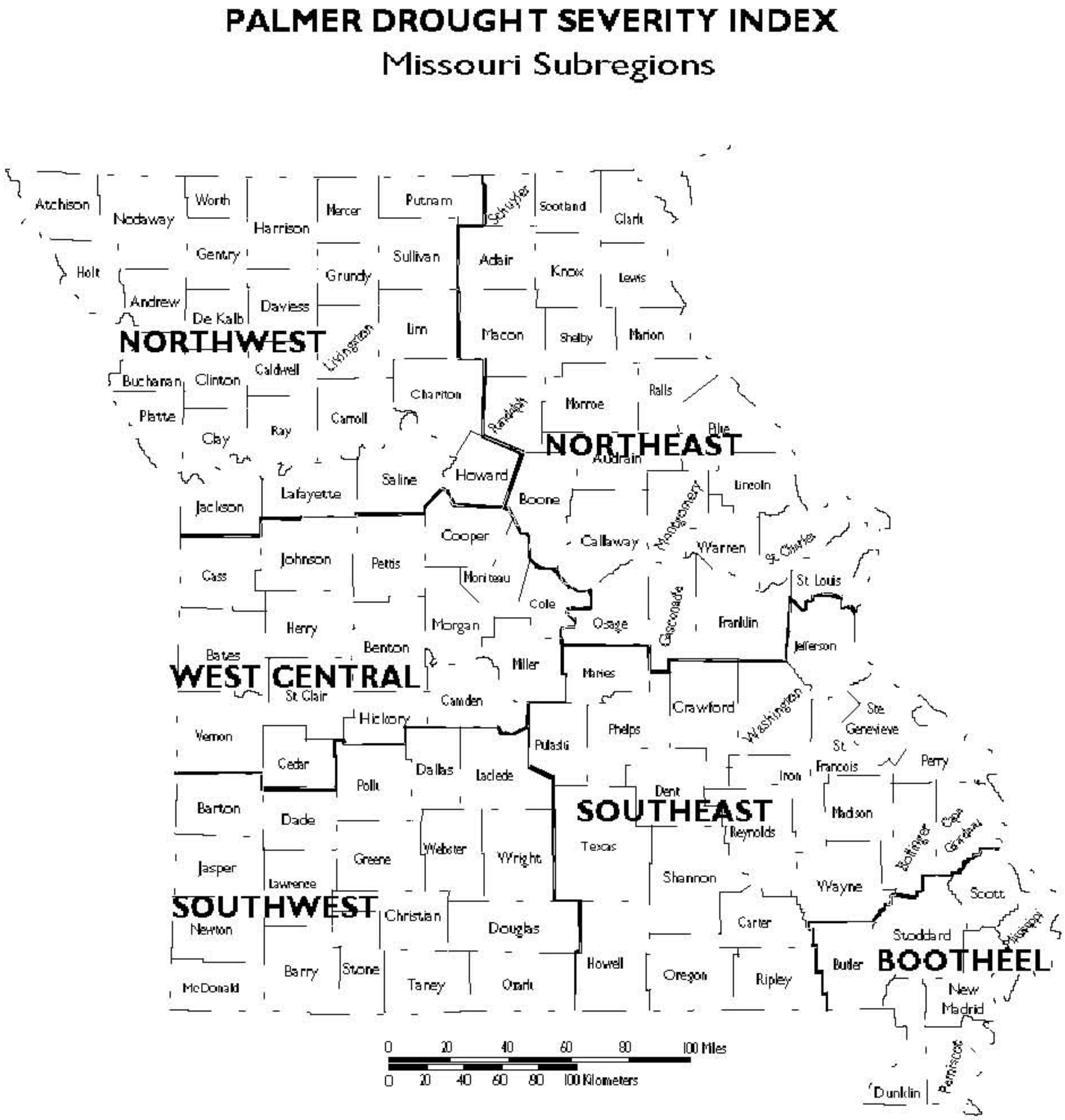
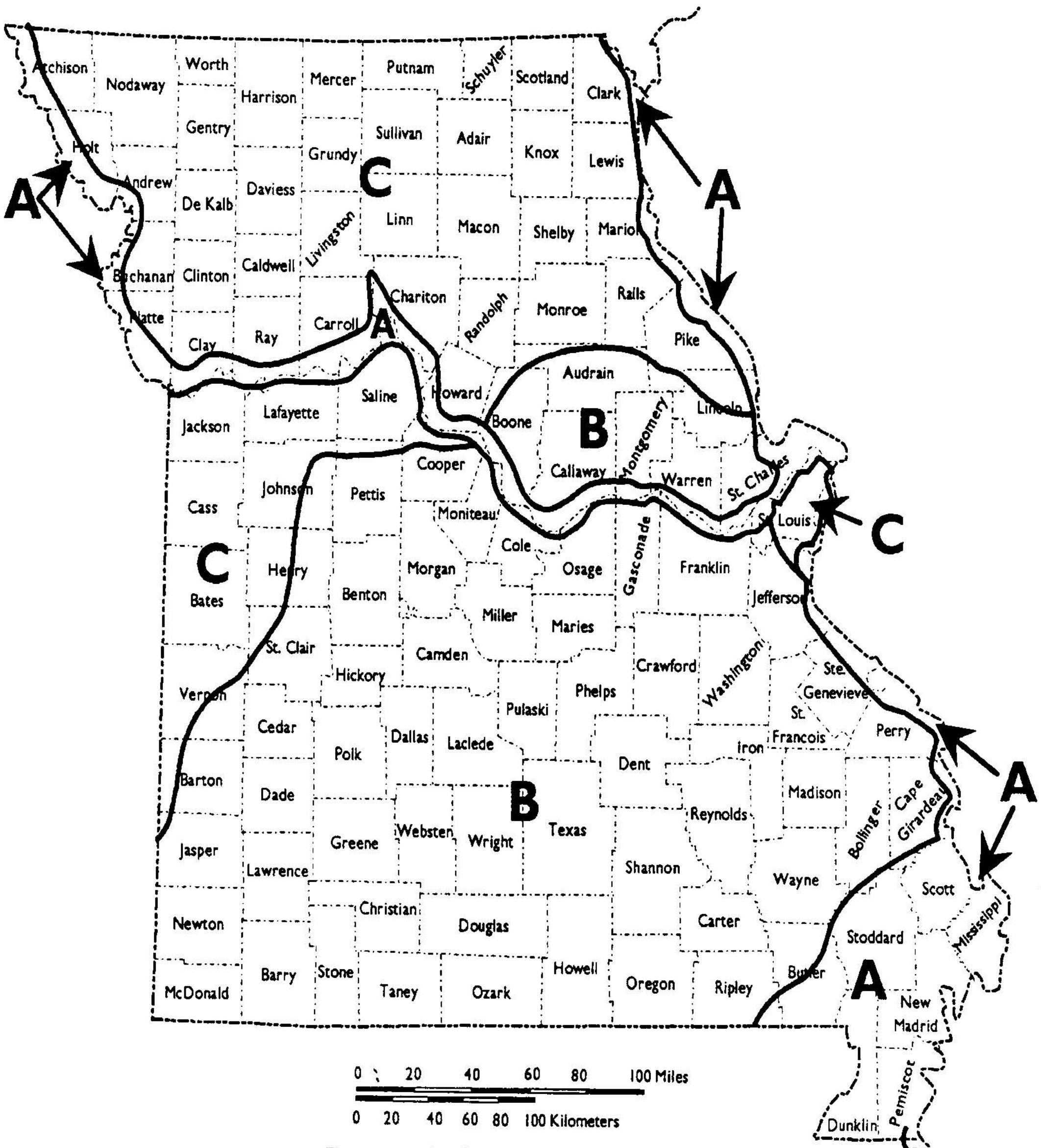

PALMER DROUGHT SEVERITY INDEX
Missouri Subregions
NORTHWEST
NORTHEAST
WEST CENTRAL
SOUTHWEST
SOUTHEAST
BOOTHEEL
Atchison
Nodaway
Worth
Harrison
Mercer
Putnam
Schuyler
Scotland
Clark
Holt
Gentry
Grundy
Sullivan
Adair
Knox
Lewis
Andrew
De Kalb
Daviess
Livingston
Linn
Macon
Shelby
Marion
Buchanan
Clinton
Caldwell
Chariton
Randolph
Monroe
Ralls
Platte
Clay
Ray
Carroll
Pike
Audrain
Saline
Howard
Boone
Lincoln
Jackson
Lafayette
Cooper
Callaway
Montgomery
Warren
St. Charles
Cass
Johnson
Pettis
Moniteau
Cole
St Louis
Henry
Benton
Morgan
Osage
Gasconade
Franklin
Bates
Miller
Maries
Jefferson
St Clair
Camden
Crawford
Washington
Ste Genevieve
Vernon
Hickory
Phelps
Pulaski
St Francois
Cedar
Dallas
Laclede
Iron
Perry
Polk
Dent
Barton
Dade
Reynolds
Madison
Greene
Webster
Wright
Texas
Bollinger
Cape Girardeau
Jasper
Lawrence
Shannon
Wayne
Scott
Newton
Christian
Douglas
Carter
Stoddard
Mississippi
Butler
McDonald
Barry
Stone
Taney
Ozark
Howell
Oregon
Ripley
New Madrid
Pemiscot
Dunklin
0 20 40 60 80 100 Miles
0 20 40 60 80 100 Kilometers

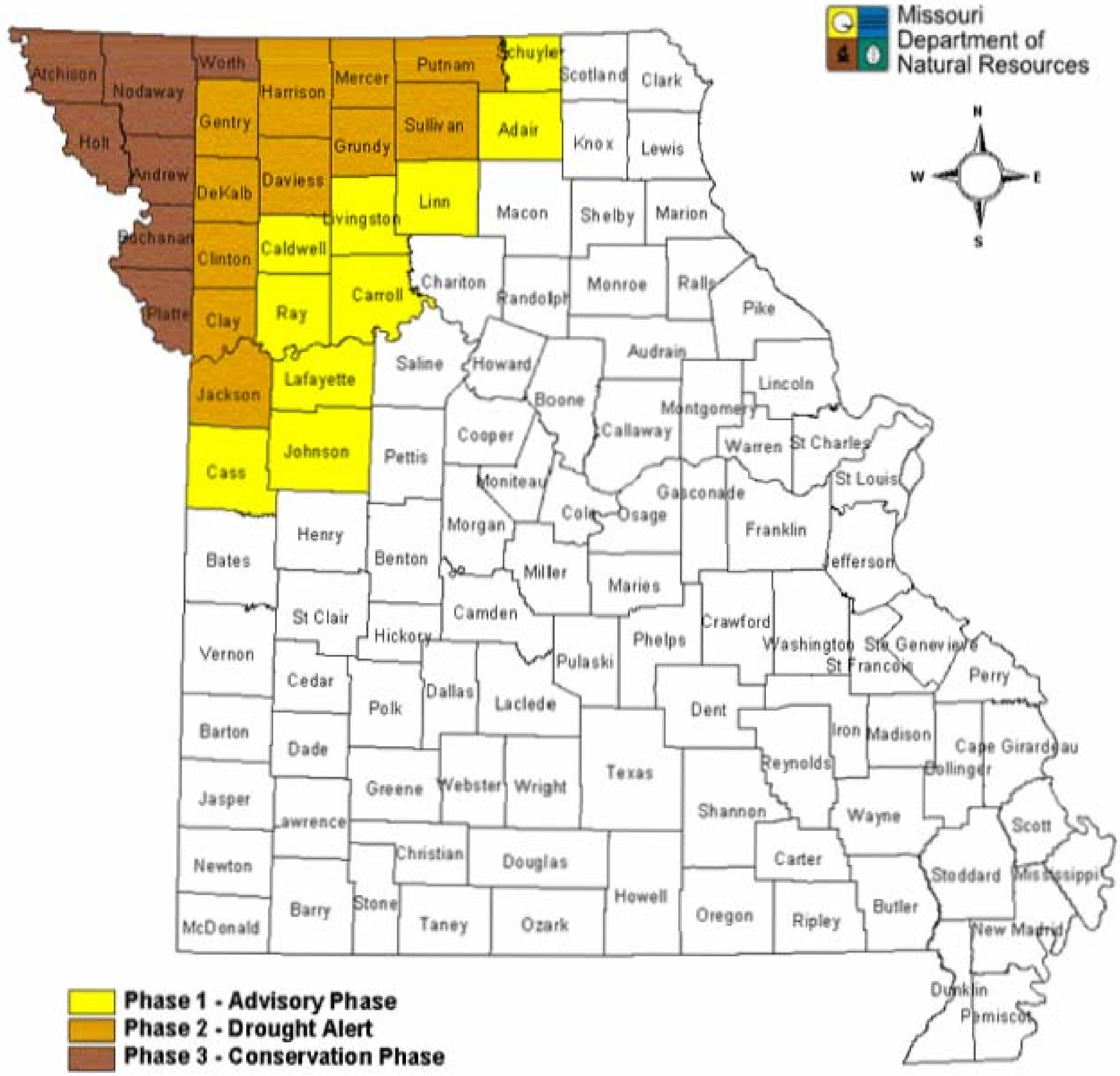
FIGURE D-2

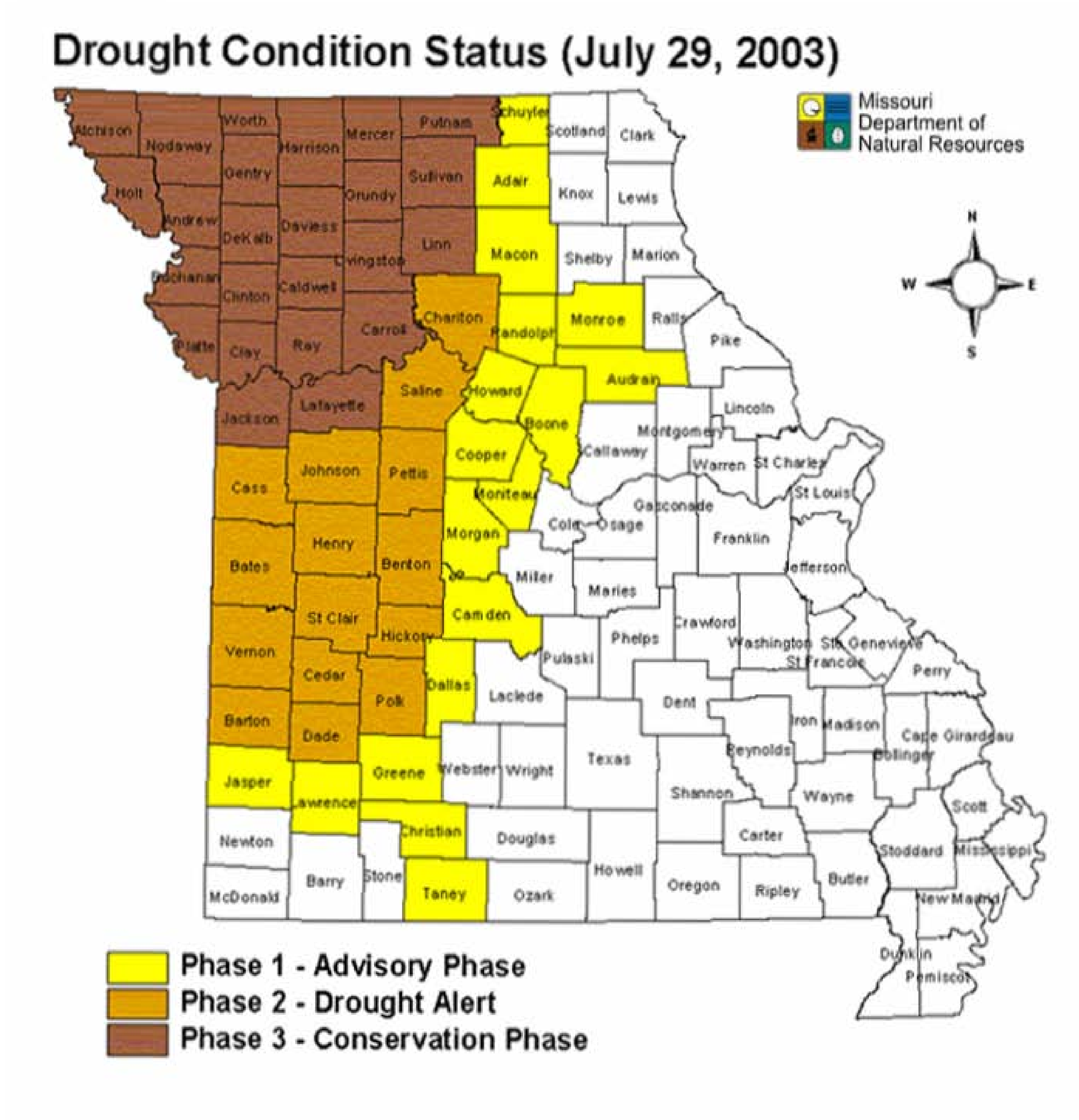
DROUGHT SUSCEPTIBILITY



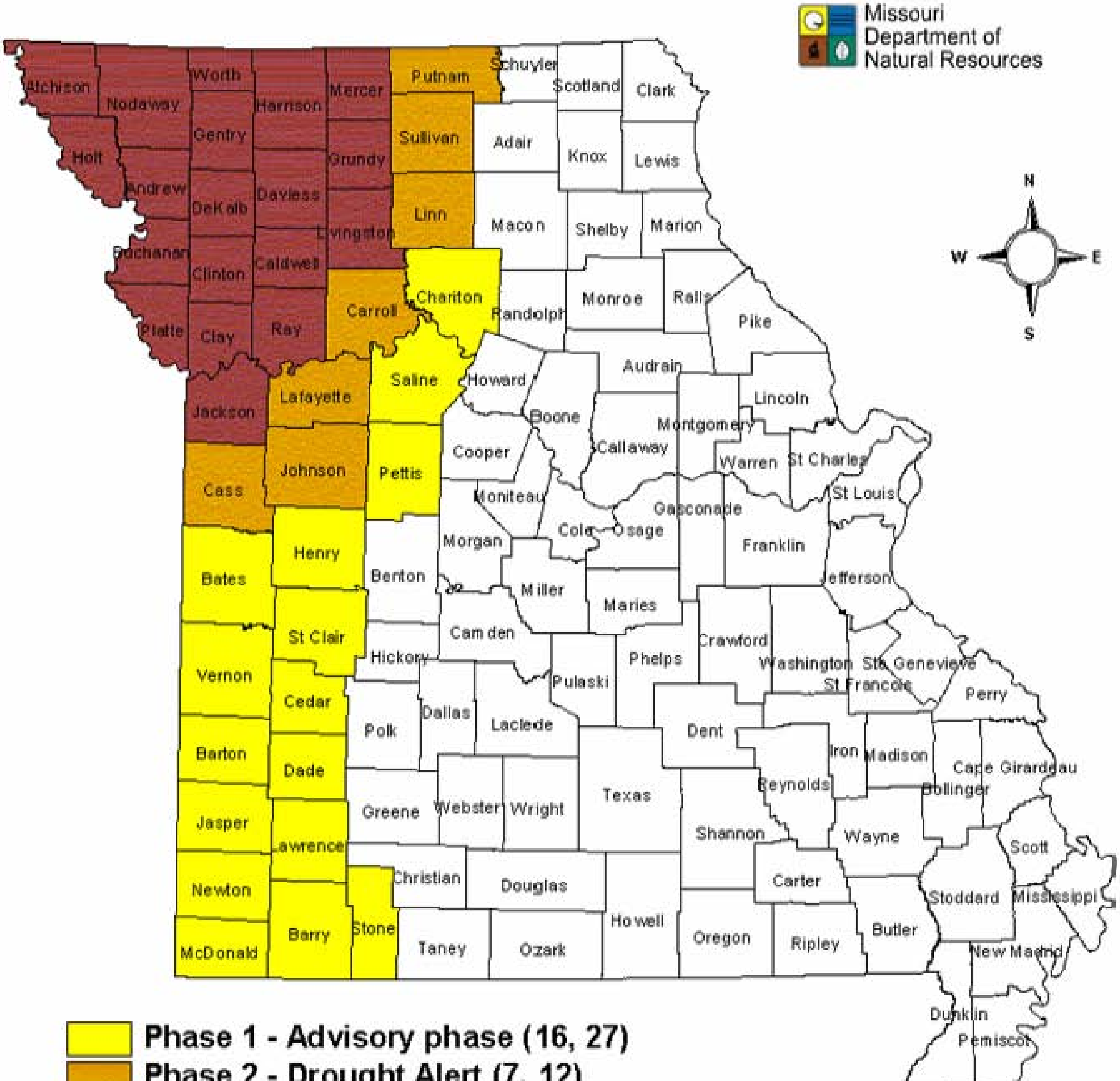
Region A: Slight Susceptibility
Region B: Moderate Susceptibility
Region C: High Susceptibility

Drought Condition Status (August 13, 2002)



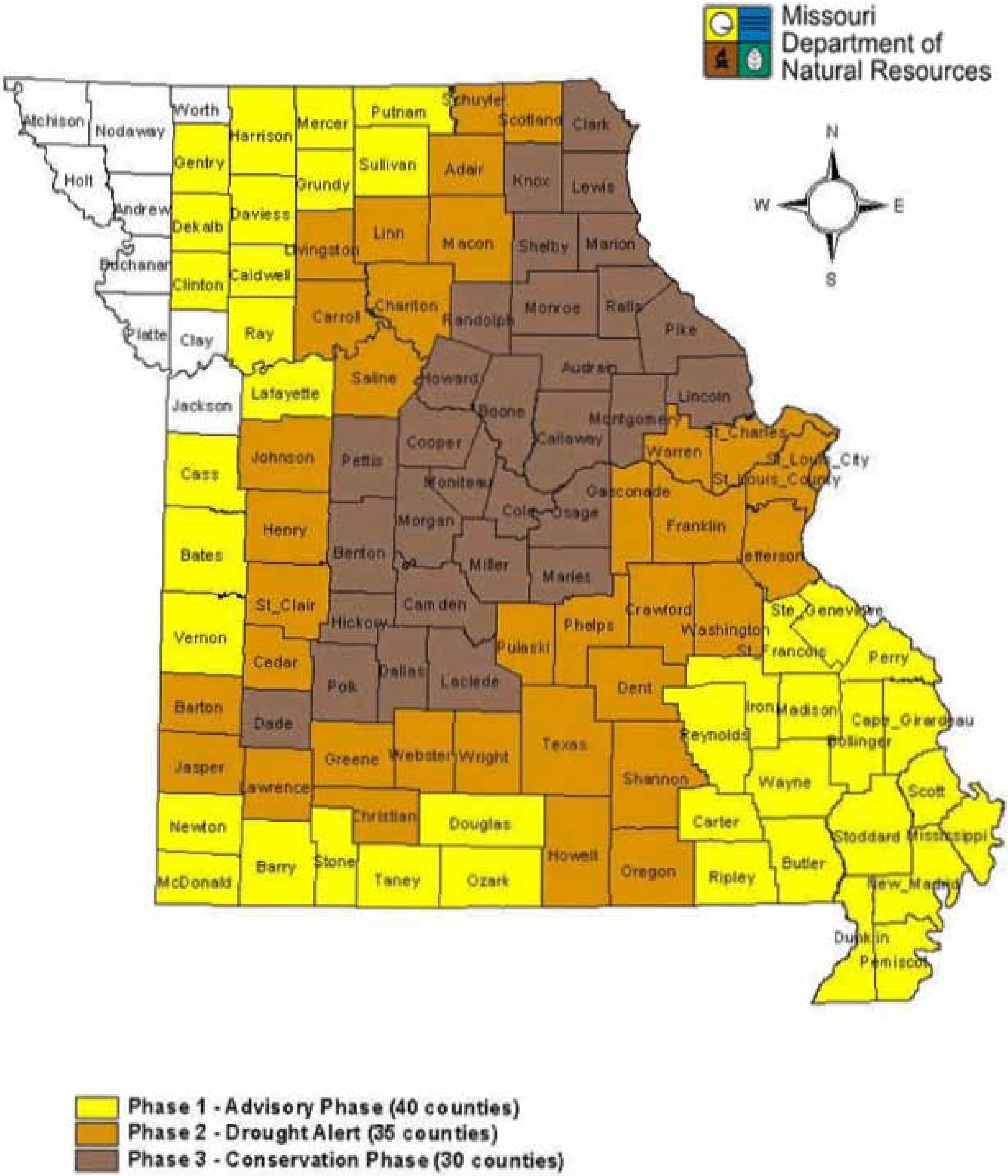

Drought Condition Status (July 29, 2003)
Missouri Department of Natural Resources
N
W
E
S
Atchison
Nodaway
Worth
Harrison
Mercer
Putnam
Schuyler
Scotland
Clark
Holt
Gentry
Grundy
Sullivan
Adair
Knox
Lewis
Andrew
DeKalb
Daviess
Linn
Macon
Shelby
Marion
Buchanan
Clinton
Caldwell
Livingston
Chariton
Randolph
Monroe
Ralls
Pike
Platte
Clay
Ray
Carroll
Audrain
Saline
Howard
Boone
Lincoln
Jackson
Lafayette
Montgomery
Callaway
Warren
St Charles
Cass
Johnson
Pettis
Cooper
Moniteau
St Louis
Gasconade
Cole
Osage
Franklin
Henry
Morgan
Bates
Benton
Miller
Maries
Jefferson
St Clair
Camden
Crawford
Phelps
Vernon
Hickory
Pulaski
Washington
Ste Genevieve
St Francois
Perry
Cedar
Dallas
Laclede
Barton
Polk
Dent
Iron
Madison
Cape Girardeau
Dade
Bollinger
Reynolds
Jasper
Greene
Webster
Wright
Texas
Lawrence
Shannon
Wayne
Scott
Newton
Christian
Douglas
Carter
Stoddard
Mississippi
McDonald
Barry
Stone
Taney
Ozark
Howell
Oregon
Ripley
Butler
New Madrid
Dunklin
Pemiscot
Phase 1 - Advisory Phase
Phase 2 - Drought Alert
Phase 3 - Conservation Phase

Drought Condition Status (January 13, 2004)



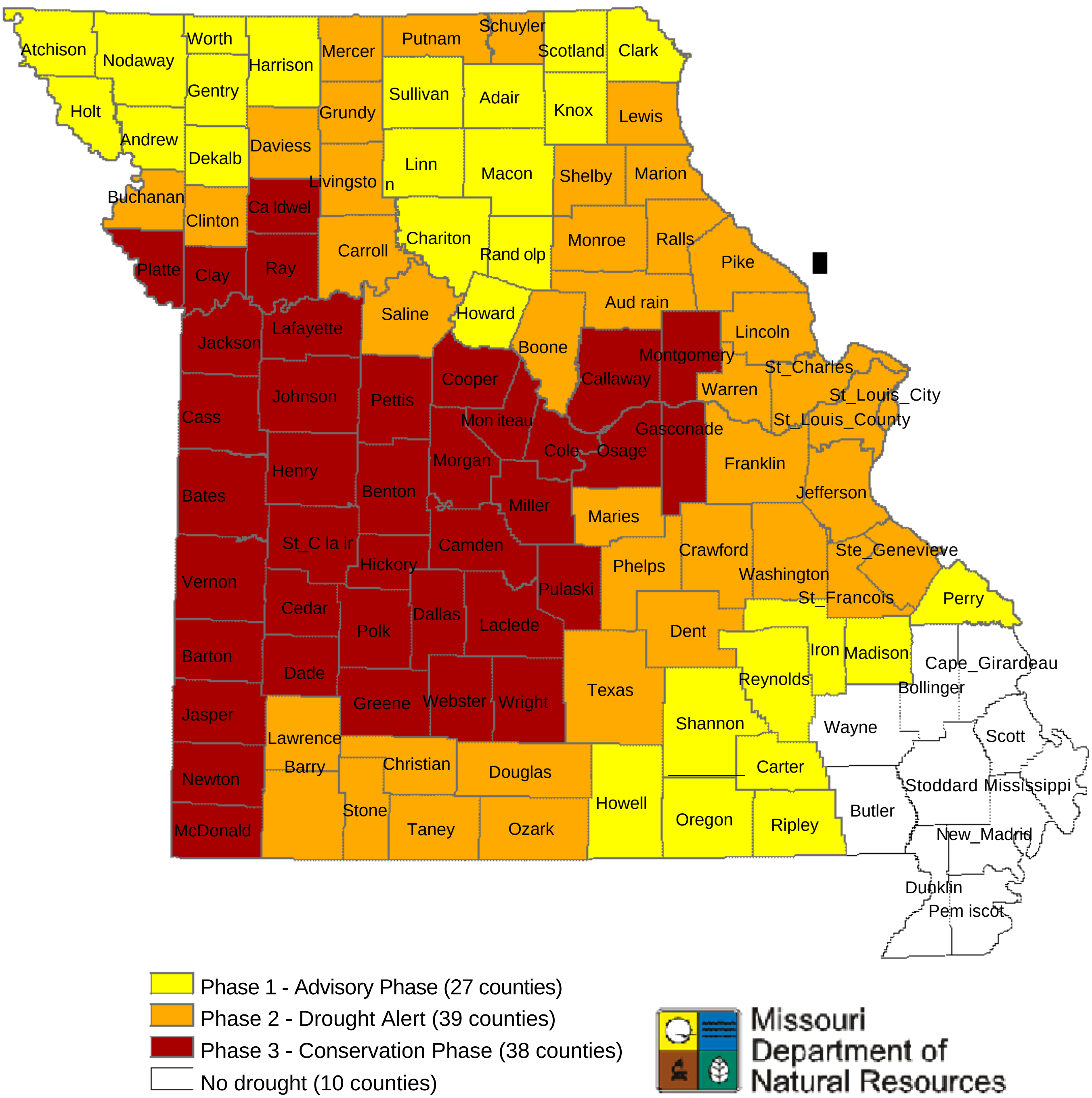
Phase 1 - Advisory phase (16, 27)
Phase 2 - Drought Alert (7, 12)
Phase 3 - Conservation Phase (19 , 25)

Drought Condition Status (July 29, 2005)



Missouri Drought Assessment Committee

Interim Drought Status (September 19, 2006)



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MDNR. "The Palmer Drought Severity Index." "Missouri Drought Susceptibility Map." www.MDNR.mo.gov/geology/wrp/wr69.pdf.

MDNR. "September 19, 2006, Interim Drought Status Map."

MDNR. Drought Information: www.MDNR.mo.gov/geology/droughtupdate.htm.

ANNEX E

HEAT WAVE

I. TYPE OF HAZARD

Heat Wave

II. DESCRIPTION OF HAZARD

A heat wave is a period of excessive heat, which can lead to illness and other stress to people with prolonged exposure to these conditions. High humidity, which often accompanies heat in Missouri, can make the effects of heat even more harmful. While heat-related illness and death can occur from exposure to intense heat in just one afternoon, heat stress on the body has a cumulative effect. Consequently, the persistence of a heat wave increases the threat to public health. The National Weather Service (NWS) defines a heat wave as three consecutive days of temperatures of 90 degrees Fahrenheit (°F) and above. These high temperatures generally occur from June through September, but are most prevalent in the months of July and August. Missouri experiences about 40 days per year above 90 °F, based on a 30-year average compiled by the NWS from 1961 through 1990. July leads this statewide mean with 15 days above 90 °F, followed by August with an average of 12 days over 90 F. June and September average 6 days and 4 days, respectively, for temperatures above 90 °F. The 30-year climatic data is from NWS stations at Kansas City, Columbia, Springfield, and St. Louis. As these regional locations indicate, all of Missouri is subject to heat wave during the summer months.

July 2006 was no exception to heat wave conditions in Missouri. The National Weather Service indicated that the July temperatures following the St. Louis storm were expected to be 91-95 within a one week period with the heat indices expected to reach 100 in the metro area at that time. A Federal disaster declaration was received on July 21, 2006, for the City of St. Louis and surrounding counties to the west and southwest of the city. Heat wave conditions continued throughout the month of July with heat indices reaching 105-115 by the end of the month. The storm event caused many households and businesses to be without power for an extended period of time. The power outages caused the heat wave to have a profound effect on individuals residing within the impacted area. By July 31, 2006, ten heat related deaths had been reported in Jefferson County, St. Louis City, and St. Louis County.

Along with humans, animals also can be affected by high temperatures and humidity. For instance, cattle and other farm animals respond to heat by reducing feed intake, increasing their respiration rate, and increasing their body temperature. These responses assist the animal in cooling itself, but this is usually not sufficient. The hotter the animal is, the more it will begin to shut down body processes not vital to its survival, such as milk production, reproduction, or muscle (meat) building.

Ambient temperature is not the only factor that should be considered when assessing the likely effects of heat. Relative humidity must also be considered, along with duration of exposure, wind, and activity. The NWS has stepped up its efforts to more effectively alert the general public and appropriate authorities to the hazards of heat waves–those prolonged episodes of excessive heat and humidity. The NWS has devised a Heat Index (HI), which is a combination of air temperature and relative humidity, and more accurately reflects the heat intensity.

The HI, given in degrees Fahrenheit, is an accurate measure of how hot it really feels when the relative humidity (RH) is added to the actual air temperature. The Heat Index Chart is shown on Figure E-1. As

an example, if the air temperature is 96 °F (found on the left side of the table), and the relative humidity is 55% (found at the top of the table), the HI is 112 °F (the intersection of the 96° row and the 55% column). Because HI values were devised for shady, light wind conditions, exposure to full sunshine can increase HI values by up to 15 °F. Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

FIGURE E-1

Temperature (F) versus Relative Humidity (%)

°F	90%	80%	70%	60%	50%	40%	30%	20%	10%
65	65.6	64.7	63.8	62.8	61.9	60.9	60.	59.1	58.1
70	71.6	70.7	69.8	68.8	67.9	66.9	66.	65.1	64.1
75	79.7	76.7	75.8	74.8	73.9	72.9	72.	71.1	70.1
80	88.2	85.9	84.2	82.8	81.6	80.4	79.	77.4	76.1
85	101.4	97.	93.3	90.3	87.7	85.5	83.5	81.6	79.6
90	119.3	112	105.8	100.5	96.1	92.3	89.2	86.5	84.2
95	141.8	131.1	121.7	113.6	106.7	100.9	96.1	92.2	89.2
100	168.7	154.	140.9	129.5	119.6	111.2	104.2	98.7	94.4
105	200	180.7	163.4	148.1	134.7	123.2	113.6	105.8	100.
110	235.	211.2	189.1	169.4	151.9	136.8	124.1	113.7	105.8
115	275.3	245.4	218	193.3	171.3	152.1	135.8	122.3	111.9
120	319.1	283.1	250.	219.9	192.9	169.1	148.7	131.6	118.2

Risk Level	Possible Heat Disorder:
Caution	Fatigue possible with prolonged exposure and physical activity.
Extreme Caution	Sunstroke, heat cramps and heat exhaustion possible.
Danger	Sunstroke, heat cramps, and heat exhaustion likely, and heat stroke possible.
Extreme Danger	Heat stroke highly likely with continued exposure.

*Note: On the HI chart, the shaded zone above 105 °F corresponds to a level that may cause increasingly severe heat disorders with continued exposure or physical activity.

Heat waves are often a major contributing factor to power outages (brownouts, etc.), as the high temperatures result in a tremendous demand for electricity for cooling purposes. Power outages for prolonged periods increase the risk of heat stroke and subsequent fatalities due to loss of cooling and proper ventilation.

Other related hazards include water shortages brought on by drought-like conditions and high demand. Local advisories, which list priorities for water use and rationing, are common during heat waves. Government authorities report that civil disturbances and riots are also more likely to occur during heat waves, as well as incidents of domestic violence and abuse.

III. HISTORICAL STATISTICS

Heat kills by taxing the human body beyond its abilities. In a normal year, approximately 175 Americans succumb to summer heat. In a 40-year period, 1936 through 1975, nearly 20,000 people died in the United States from the effects of heat and solar radiation. Over the past nine decades, the Missouri State Department of Health has compiled statistics for deaths from excessive heat. Figure E-2 in Section VII depicts the number of deaths in Missouri from 1911 to 2000. In 2001, it was reported that 47 Missourians died due to heat-related causes. In 2002, 24 persons died in Missouri due to heat. In United States, some of the worst years for heat-related deaths occurred during the Great Depression, with 843 deaths in 1934, and 644 in 1936. The worst year in the past few decades was 1980, with 1,250 deaths from excessive heat.

IV. MEASURE OF PROBABILITY AND SEVERITY

Based on 30-year statistics from the NWS indicating the state's mean number of days above 90 °F, Missouri is vulnerable to heat waves ranging from high to moderate risk in July and August. The NWS has developed a Heat Index/Heat Disorder Chart that relates ranges of HI with specific disorders, particularly for people in higher risk groups (Table E-1).

TABLE E-1

Heat Index	Heat Disorder
130 °F or higher	Heat stroke or sunstroke likely with continued exposure
105 to 129 °F	Sunstroke, heat cramps, or heat exhaustion likely, and heat stroke possible with prolonged exposure or physical activity
90 to 104 ° F	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure or physical activity
80 to 89 °F	Fatigue possible with prolonged exposure or physical activity

Table E-2 shows the three response levels developed by the NWS, based on the Heat Index, to alert the public to the potential heat hazards:

TABLE E-2

Heat Index	Response Level
130 °F or higher	Warning
105 to 129 °F	Watch
90 to 104 °F	Advisory

Based on information from the Department of Health and Senior Services and the NWS, the State rates the probability of a heat wave as moderate and severity as moderate, but the probability could be upgraded to severe.

The Missouri Department of Health and Senior Services will announce a statewide hot weather health alert (Table E-3), when the conditions are as follows:

TABLE E-3

Type of Alert	Conditions of Alert
Hot Weather Health Alert	Heat indices of 105 °F in a large portion of the state are first reached (or predicted).
Hot Weather Health Warning	Heat indices have been 105 °F or more for 2 days in a large portion of the state; or weather forecasts call for continued heat stress conditions for at least 24 to 48 hours, over a large portion of the state.
Hot Weather Health Emergency	When extensive areas of the state meet the following criteria: (1) High sustained level of heat stress (HI 105 °F for 3 days), (2) Increased numbers of heat-related illnesses and deaths statewide, and (3) The NWS predicts hot, humid temperatures for the next several days for a large portion of the state.

V. IMPACT OF THE HAZARD

The severity of heat disorders tends to increase with age. Heat cramps in a 17-year-old can become heat exhaustion for someone in their forties, and may result in a fatal stroke for someone in their sixties. The following table lists conditions associated with heat, their symptoms and suggested first aid.

TABLE E-4

Heat Disorder	Symptoms	First Aid
Sunburn	Redness and pain. In severe cases, swelling of skin, blisters, fever, and headaches.	Apply ointment for mild cases if blisters appear. If breaking occurs, apply dry sterile dressing. Serious, extensive cases should be seen by physician.
Heat Cramps	Painful spasms possible usually in muscles of legs and abdomen. Heavy sweating.	Apply firm pressure on cramping muscles, or gentle massage to relive spasms. Give sips of water.
Heat Exhaustion	Heavy sweating and weakness; cold, pale and clammy skin. Pulse thready. Normal temperature possible. Fainting and vomiting.	Get victim out of sun. Lie down and loosen clothing. Apply cool wet cloths. Fan or move victim to air conditioned room. Give sips of water. If vomiting continues, seek immediate medical attention.

Heat Disorder	Symptoms	First Aid
Heat Stroke (or Sunstroke)	High body temperature (106 °F, or higher). Hot dry skin. Rapid and strong pulse. Possible unconsciousness.	Heat stroke is a severe medical emergency. Summon medical assistance or get the victim to a hospital immediately. Delay can be fatal. Move the victim to cooler environment. Reduce body temperature with cold bath or sponging. Use extreme caution. Remove clothing. Use fans and air conditioners. If temperature rises again, repeat process. Do not give fluids.

The following population groups are at a greater risk to becoming very sick from heat waves:

A. Those Vulnerable To Heat Stress Due To Physical Condition

1. Older people
2. Children
3. People overweight or underweight.

B. People With Limited Independence Due To Physical or Mental Disorders

1. People in institutional settings without air conditioning
2. People working in heat under stress (firefighters, police, emergency medical technicians)
3. People in urban environments where heat retention in asphalt, concrete and masonry is a factor (heat island effect)
4. People with low income who lack resources for air conditioning, transportation, medical care, etc.

C. Those With Increased Risk From Work or Leisure Activities

1. People who work outdoors (utility crews, construction crews, etc.)
2. Military personnel and trainees
3. Athletes.

D. Those More Difficult To Reach Through Normal Communications

1. People who live alone
2. People who are homeless
3. People who do not speak English
4. People who cannot read
5. People who are culturally, socially, or geographically isolated.

Even when a heat injury isn't fatal, it can be extremely serious and require lifelong monitoring of further exposure to heat. Besides mortality statistics due to heat, the Missouri Department of Health and Senior Services tracks heat-related injuries. Figure E-3 in Section VII shows heat-related illnesses in Missouri from 1991 through 2000.

As previously mentioned, animals can be adversely affected by heat stress. This poses a risk to farmers, ranchers, and the entire State of Missouri, which relies on agricultural revenue to keep the economy strong. Livestock producers cannot afford to ignore the effects of high temperatures on their herds. The following symptoms are signs of heat stress on livestock:

- Restlessness and crowding under shade or at water tanks/areas
- Open-mouthed breathing or panting and increased salivating
- Increased respiration rates
- Gasping and lethargic demeanor.

VI. SYNOPSIS

Many people do not realize how deadly a heat wave can be. In contrast to the visible, destructive, and violent nature of floods, hurricanes, and tornadoes, a heat wave is a "silent killer." Be aware of the warning signs of heat-related illness, such as light-headedness, mild nausea or confusion, sleepiness, or profuse sweating. To prevent heat-related illness, take the following precautions:

- Increase your fluid intake; drink more liquids than your thirst indicates.
- Drink nonalcoholic and caffeine-free liquids, such as water and juices.
- Wear lightweight, light colored, loose-fitting clothing.
- When unaccustomed to working or exercising in a hot environment, start slowly and pick up the pace gradually; rest frequently in a shady area.
- Spend time in an air-conditioned place; if not at home, then spend time in such public places as libraries, supermarkets, shopping malls, and movie theatres.
- Do not rely on fans as your primary cooling devices during a heat wave.
- Schedule outdoor activities carefully, preferably before noon or in the evening.
- When working in the heat, monitor the condition of your co-workers and have someone do the same for you.
- Monitor those at high risk, such as the elderly, infants, and children up to 4 years of age, someone who is overweight, or someone on medication.

- Ask your physician whether you are at particular risk because of medication.
- Do not leave infants, children, or pets unattended in a parked car or other hot environments.

Although fans are less inexpensive to operate, they may not be effective, and may even be harmful when temperatures are very high. As the air temperature rises, airflow is increasingly ineffective in cooling the body until finally, at temperatures above 100 °F (the exact number varies with the humidity), increasing air movement actually increases heat stress. More specifically, when the temperature of the air rises to about 100 °F, the fan may be delivering overheated air to the skin at a rate that exceeds the capacity of the body to get rid of this heat, even with sweating, and the net effect is to add heat rather than to cool the body. An air conditioner, if one is available, is a much better alternative. More information on heat-related illness is available through the Department of Health's web page at www.health.state.mo.us/ColdAndHeat/CandH.html.

VII. MAPS OR OTHER ATTACHMENTS

Attached are the Missouri Department of Health statistics for heat-related illnesses and deaths.

- Heat-Related Death Chart: Figure E-2
- Number of Heat-Related Illnesses in Missouri in 1991-2000: Figure E-3.

FIGURE E-2

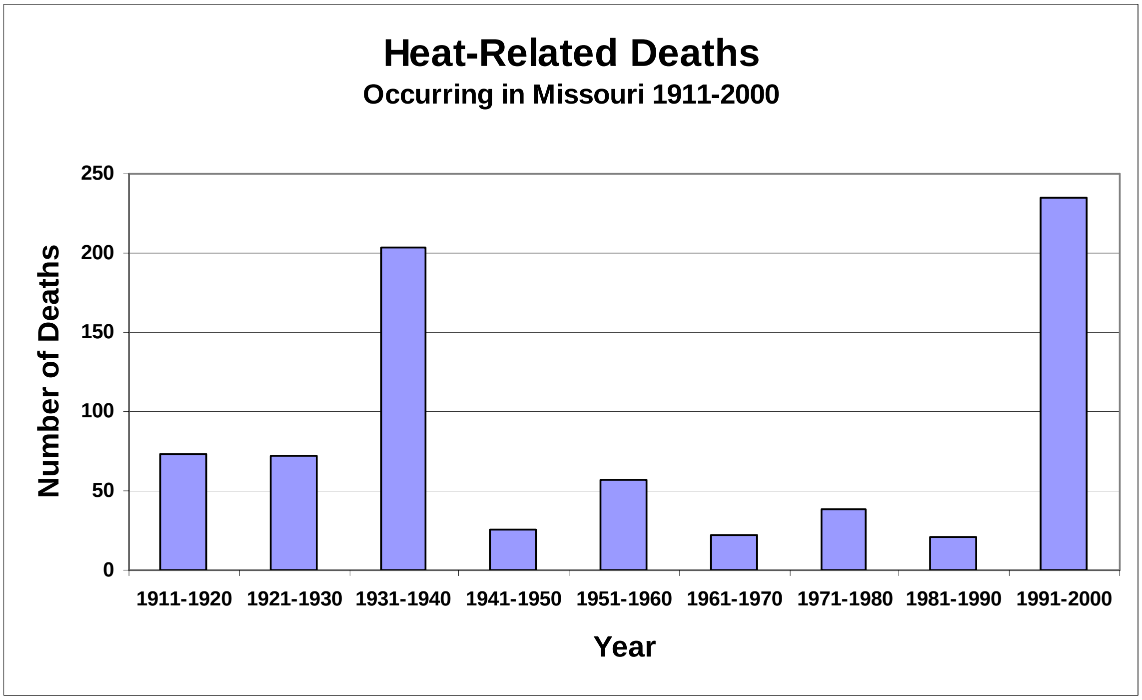
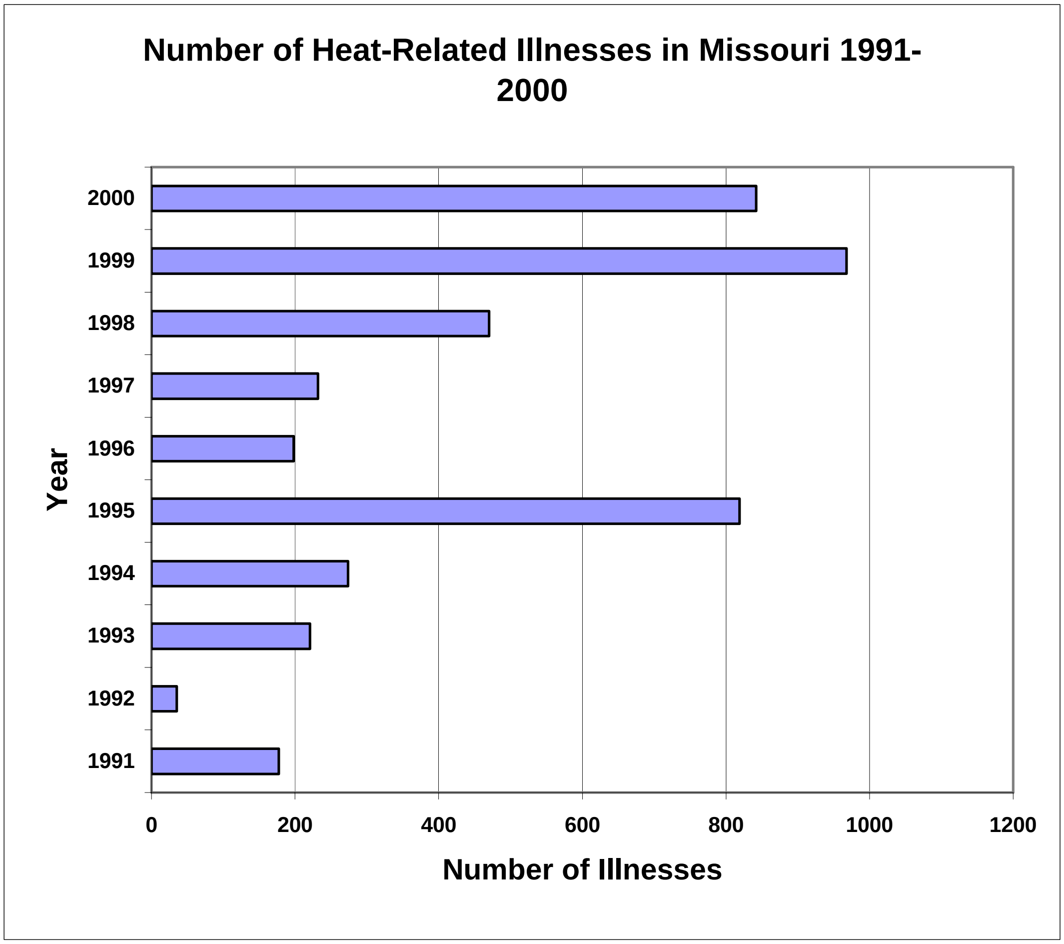

Heat-Related Deaths
Occurring in Missouri 1911-2000
Number of Deaths
250
200
150
100
50
0
1911-1920
1921-1930
1931-1940
1941-1950
1951-1960
1961-1970
1971-1980
1981-1990
1991-2000
Year

FIGURE E-3



Number of Heat-Related Illnesses in Missouri 1991-2000
2000
1999
1998
1997
1996
1995
1994
1993
1992
1991
Year
0
200
400
600
800
1000
1200
Number of Illnesses

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ANNEX F

EARTHQUAKES

I. TYPE OF HAZARD

Earthquakes

II. DESCRIPTION OF HAZARD

Earthquakes are defined as shifts in the earth's crust causing the surface to become unstable. This instability can manifest itself in intensity from slight tremors to large shocks. The duration can be from a few seconds up to 5 minutes. The period of tremors (and shocks) can last up to several months. The larger shocks can cause ground failure, landslides, liquefaction, uplifts, and sand blows.

The earth's crust is made up of gigantic plates, commonly referred to as tectonic plates. These plates form what is know as the lithosphere, which varies in thickness from 6.5 miles (beneath oceans) to 40 miles (beneath mountain ranges), and has an average thickness of 20 miles. These plates "float" over a partly melted layer of crust called the asthenosphere. The plates are in motion, and areas where one plate joins another are referred to as “plate boundaries.” Areas where the plates are moving toward each other are called convergent plate boundaries, and areas when they are moving away from each other are called divergent plate boundaries. The San Andreas Fault in California is a horizontal motion boundary, where the Pacific plate is moving to the north while the North American plate is moving to the west. These movements release built-up energy in the form of earthquakes, tremors, and volcanic activity. Fault lines such as the San Andreas come all the way to the surface and can be readily seen and identified. Some fault lines do not come all the way to the surface, yet they can store and release energy when they move. Many of the faults in the central United States are characterized this way.

The subterranean faults were formed many millions of years ago on or near the surface of the earth. Subsequent to that time, these ancient faults subsided, while the adjacent areas were pushed up. As this fault zone (also known as a rift) lowered, sediments filled in the lower areas. Under pressure, sediments hardened into limestones, sandstones, and shales, thus burying the rifts. With the pressure on the North Atlantic ridge affecting the eastern side of the North American plate, and the movements along the San Andreas Fault by the Pacific plate, the buried rift system, in the Mississippi embayment has been reactivated. This particular rift system is now called the Reelfoot Rift.

Eight earthquake seismic zones are located in the central United States, two of which are located within the State of Missouri. The most active zone is the New Madrid Seismic Zone, which runs from northern Arkansas through southeast Missouri and western Tennessee and Kentucky to the Illinois side of the Ohio River Valley. Other zones, because of their close proximity, also affect Missourians. These are the Wabash Valley Fault, Illinois Basin, and the Nemaha Uplift.

The Nemaha Uplift is of concern to Missourians because it runs parallel to the Missouri/Kansas border from Lincoln, Nebraska, to Oklahoma City, Oklahoma. Earthquakes from the Nemaha Uplift are not as severe as those associated with the historic New Madrid seismic zone, several earthquakes have affected Missouri in the past.

III. HISTORICAL STATISTICS

The most severe earthquakes occurred in the New Madrid seismic zone during a period between December 16, 1811, and March 12, 1812. An engineer in Louisville, Kentucky, counted over 1,850 shocks during this time, including three earthquakes of magnitude greater than 8.3 (Richter magnitude). The shocks from these earthquakes could be easily felt as far away as Detroit, Michigan, and Charleston, South Carolina. The area between the St. Francois River and Mississippi River south of New Madrid to Marked Tree, Arkansas, showed numerous sand blows. A sand blow is a place where liquefacted alluvial soil has geysered out of the surface. Liquefaction is a phenomenon where the shaking of the ground separates the water from the soil holding it, causing the soil to behave like a dense liquid. The lack of water causes the soil to lose surface cohesion, and sand from these blows accumulates to a depth of up to 5 feet in places. Liquefaction causes land to lose its load-bearing capacity.

Areas uplifted as well as subsided (dropped) along the Mississippi River. For instance, the area around Tiptonville, Tennessee, formed a dome (uplift of several yards). Immediately adjacent to the Tiptonville Dome, an area subsided to form a lake 18 miles long and 5 miles wide. It is now known as Reelfoot Lake and is a tourist and recreation area. Ground failure and landslides were apparent throughout the bluffs (Chickasaw Bluffs) alongside the Mississippi River in Kentucky and Tennessee. Many fissures were made throughout the region, and one local observer recorded that the earth seemed to be rolling in waves a few feet in height. These swells would burst, leaving wide and long fissures. The damage to the area was so severe that Congress passed, and President James Madison signed into law, the first disaster relief act, giving government lands in other territories to people wanting to move out of the area.

Mostly recently along Nemaha Seismic Zone, an earthquake of 3.1 Richter magnitude occurred on March 31, 1993, close to the Cooper Nuclear Power Station in Brownville, Nebraska. No damages resulted, but the earthquake was felt across the Missouri River near Rock Port, Missouri.

IV. MEASURE OF PROBABILITY AND SEVERITY

The Center for Earthquake Research and Information at the University of Memphis has computed conditional probabilities of a magnitude 6.0 Richter earthquake in the New Madrid seismic zone. According to a fact sheet prepared by State Emergency Management Agency (SEMA) in 2003, the probability for a magnitude 6.0 to 7.5 or greater earthquake along the New Madrid Fault is 25 to 40 percent over the next 50 years. With approximately 12.5 million people living in the area, steps are being taken to reduce related hazards to citizens and property in the area. The probability of an earthquake increases with each day, which makes it difficult to rate. Based on the information from the Center for Earthquake Research and Information (University of Memphis), the probability of an earthquake is rated as moderate, and the severity is rated as high.

V. IMPACT OF THE HAZARD

The impacts of earthquakes on Missouri can be significant. The three New Madrid earthquakes of 1811-1812 may be the largest that have happened on the North American continent. Although losses were limited because of the sparse population of the time, many Native Americans died and property was damaged to the point that resettlement became a national policy.

Several studies indicate the need to prepare for earthquakes, as scholars estimate that the New Madrid Seismic Zone has the capability of generating Mercalli intensities of X (ten) in Southeast Missouri. The late Dr. Otto Nuttli of St. Louis University stated in his book, "The Effects of Earthquakes in the Central United States," that surface-wave magnitudes of 7.6 (Richter) would create the largest possible

earthquake that could occur anywhere along the New Madrid Seismic Zone in the near future. Information on preparedness and predictions related to the New Madrid Seismic Zone is provided on the U. S. Geological Survey Earthquake Hazards Program website: www.usgs.gov/hazards, and the Center for Earthquake Research and Information website: www.ceri.memphis.edu/usgs.

VI. SYNOPSIS

The chances of an earthquake increase each day. Energy from the movement of the North American tectonic plate continues to build up along both the New Madrid and Nemaha Seismic Zones and their subsidiary systems. The state will have an earthquake. We don't know exactly where or when, but we are overdue for a moderate earthquake. The earthquakes may affect the citizens of Missouri and surrounding states. Earthquakes also have secondary effects such as fires, building collapses, utility disruptions, flooding, hazardous materials releases, environmental impacts, and economic disruptions or losses.

VII. MAPS OR OTHER ATTACHMENTS

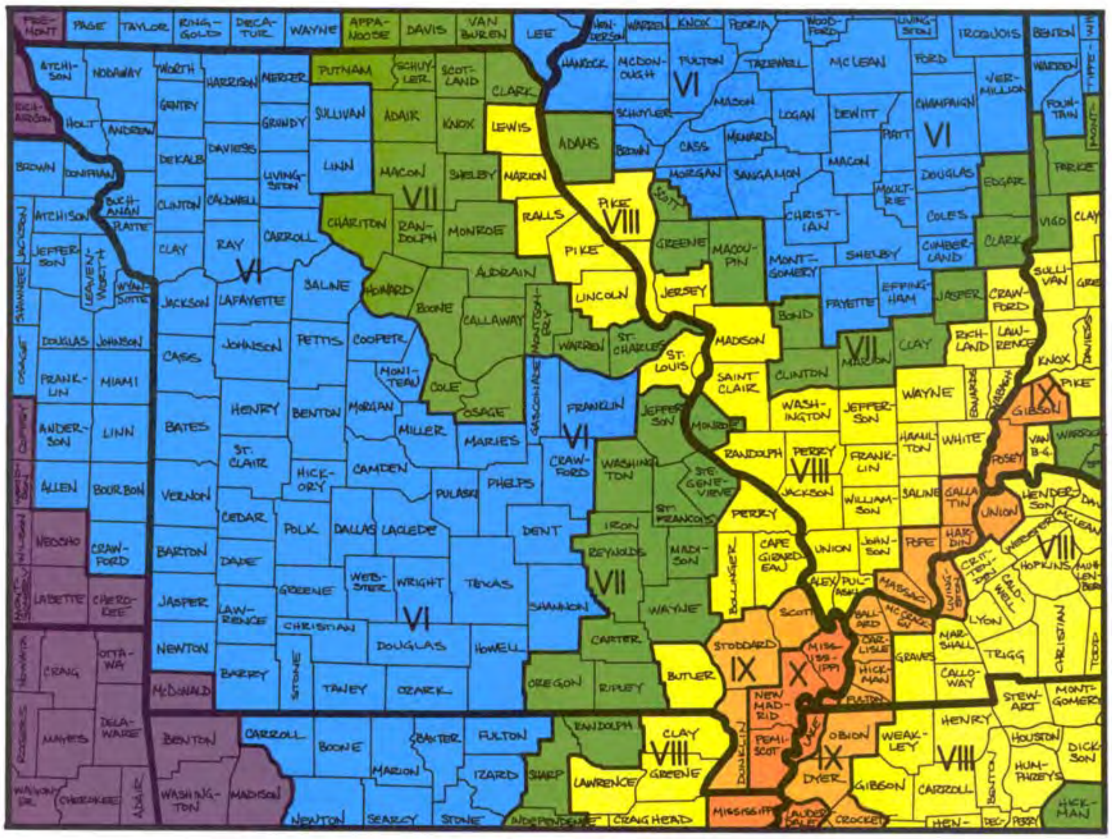
The attached figure shows the projected Modified Mercalli earthquake intensities by county expected from a 7.6 Richter magnitude earthquake along the New Madrid Seismic Zone. The secondary maps show the same relative intensities for these statewide regions for a 6.7 and an 8.6 Richter magnitude earthquake, respectively. The Modified Mercalli Intensity Scale descriptions are included following the maps in the figure. The intensity is a numerical index scale to describe the effects of an earthquake on the surface of the Earth, on man, and on man-made structures. Further discussion on this is included following the scale legend.

- Projected Earthquake Intensities: Figure F-1
- Moderate/Large Earthquakes in the Central United States.

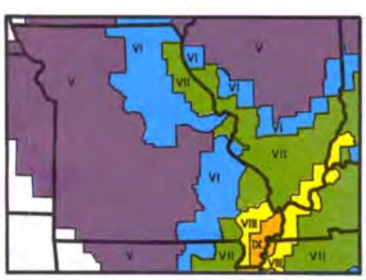
FIGURE F-1

PROJECTED EARTHQUAKE INTENSITIES

This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone. The secondary maps show the same regional intensities for a 6.7 and an 8.6 earthquake, respectively. For a description of Projected Earthquake Intensities V through X, see the page following the maps.



This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 7.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.



This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 6.7 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 8.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

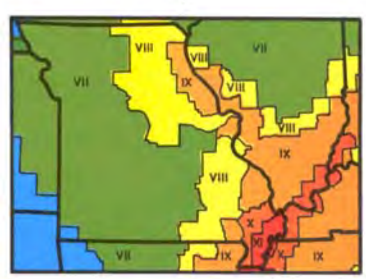


FIGURE F-1 (Continued)

PROJECTED EARTHQUAKE INTENSITIES

MODIFIED MERCALLI INTENSITY SCALE

I People do not feel any Earth movement.

II A few people might notice movement.

III Many people indoors feel movement. Hanging objects swing.

IV Most people indoors feel movement. Dishes, windows, and doors rattle. Walls and frames of structures creak. Liquids in open vessels are slightly disturbed. Parked cars rock.

V Almost everyone feels movement. Most people are awakened. Doors swing open or closed. Dishes are broken. Pictures on the wall move. Windows crack in some cases. Small objects move or are turned over. Liquids might spill out of open containers.

VI Everyone feels movement. Poorly built buildings are damaged slightly. Considerable quantities of dishes and glassware, and some windows are broken. People have trouble walking. Pictures fall off walls. Objects fall from shelves. Plaster in walls might crack. Some furniture is overturned. Small bells in churches, chapels and schools ring.

VII People have difficulty standing. Considerable damage in poorly built or badly designed buildings, adobe houses, old walls, spires and others. Damage is slight to moderate in well-built buildings. Numerous windows are broken. Weak chimneys break at roof lines. Cornices from towers and high buildings fall. Loose bricks fall from buildings. Heavy furniture is overturned and damaged. Some sand and gravel stream banks cave in.

VIII Drivers have trouble steering. Poorly built structures suffer severe damage. Ordinary substantial buildings partially collapse. Damage slight in structures especially built to withstand earthquakes. Tree branches break. Houses not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Temporary or permanent changes in springs and wells. Sand and mud is ejected in small amounts.

IX Most buildings suffer damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks conspicuously. Reservoirs suffer severe damage.

X Well-built wooden structures are severely damaged and some destroyed. Most masonry and frame structures are destroyed, including their foundations. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, and lakes. Railroad tracks are bent slightly. Cracks are opened in cement pavements and asphalt road surfaces.

XI Few if any masonry structures remain standing. Large, well-built bridges are destroyed. Wood frame structures are severely damaged, especially near epicenters. Buried pipelines are rendered completely useless. Railroad tracks are badly bent. Water mixed with sand, and mud is ejected in large amounts.

XII Damage is total, and nearly all works of construction are damaged greatly or destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move. Lakes are dammed, waterfalls formed and rivers are deflected.

Intensity is a numerical index describing the effects of an earthquake on the surface of the Earth, on man, and on structures built by man. The intensities shown in these maps are the highest likely under the most adverse geologic conditions. There will actually be a range in intensities within any small area such as a town or county, with the highest intensity generally occurring at only a few sites. Earthquakes of all three magnitudes represented in these maps occurred during the 1811 - 1812 "New Madrid earthquakes." The isoseismal patterns shown here, however, were simulated based on actual patterns of somewhat smaller but damaging earthquakes that occurred in the New Madrid seismic zone in 1843 and 1895.

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FIGURE 1

MODERATE/LARGE EARTHQUAKES IN THE CENTRAL UNITED STATES

DATE	LOCALITY	MAGNITUDE	MAXIMUM INTENSITY	SOURCE ZONE
Dec. 16, 1811	New Madrid, Missouri	8.6	XII	New Madrid Fault
Jan. 23, 1812	New Madrid, Missouri	8.0	XII	New Madrid Fault
Feb. 7, 1812	New Madrid, Missouri	8.0	XII	New Madrid Fault
June 9, 1838	Southern Illinois	5.7	VI	Illinois Basin
Jan. 4, 1843	Western Tennessee	6.3	VIII	New Madrid Fault
Unknown, 1860	Central Minnesota	5.0	Unknown	Colorado Lineament
Aug. 17, 1865	Southeastern Missouri	5.3	VII	New Madrid Fault
April 24, 1867	Lawrence, Kansas	5.1	VII	Nemaha Uplift
June 18, 1875	Western Ohio	5.3	VII	Cincinnati Arch
Nov. 15, 1877	Eastern Nebraska	5.0	VII	Nemaha Uplift
Oct. 22, 1882	Arkansas - Texas	5.5	VI - VII	Ouchita - Wichita Fault
July 26, 1891	Illinois - Indiana	5.9	VI	Wabash Valley Fault
Oct. 31, 1895	Charleston, Missouri	6.7	VIII	New Madrid Fault
May 26, 1909	Illinois	5.1	VII	Cincinnati Arch
April 9, 1917	Eastern Missouri	5.0	VI	St. Francois Uplift
March 8, 1937	Western Ohio	5.0	VII - VIII	Cincinnati Arch
April 9, 1952	Enid, Oklahoma	5.1	VII	Nemaha Uplift
Nov. 9, 1968	South Central Illinois	5.5	VII	Wabash Valley Fault
March 24, 1976	Marked Tree, Arkansas	5.0	V - VI	New Madrid Fault
July 27, 1980	North Central Kentucky	5.2	VII	Cincinnati Arch
Jan. 31, 1986	Anna, Ohio	5.0	VI	Cincinnati Arch
June 9, 1987	Lawrenceville, Illinois	5.2	V - VI	Wabash Valley Fault
Sept. 26, 1990	Chaffee, Missouri	3.0	IV - V	New Madrid Fault
May 3, 1991	Risco, Missouri	4.6	IV - V	New Madrid Fault
June 26, 2000	Harrison, Arkansas	3.9	VIII	Ouchita – Wichita Fault
Dec. 7, 2000	Evansville, Indiana	3.9	V	Wabash Valley Fault
May 4, 2001	Conway, Arkansas	4.4	VI	Ouchita - Wichita Fault
February 8, 2002	Lewton, Oklahoma	3.9	V	Nemaha Uplift
June 18, 2002	Evansville, Indiana	4.6	VI	Wabash Valley Fault
November 3, 2002	O'Neill, Nebraska	4.3	V	Nemaha Uplift
June 6, 2003	Cairo, Illinois	4.0	VI	New Madrid Fault
August 16, 2003	West Plains, Missouri	4.0	V	New Madrid Fault
June 15, 2004	Sikeston, Missouri	3.7	V	New Madrid Fault
June 28, 2004	Ottawa, Illinois	4.2	VI	Illinois Basin
September 17, 2004	Middlesboro, Kentucky	3.7	V	New Madrid Fault
February 10, 2005	Blytheville, Arkansas	4.1	V	New Madrid Fault
May 1, 2005	Blytheville, Arkansas	4.1	V	New Madrid Fault
June 2, 2005	Dyersburg, Tennessee	4.0	IV	New Madrid Fault
August 24, 2005	Greeneville, Tennessee	3.7	IV	New Madrid Fault
January 2, 2006	Harrisburg, Illinois	3.6	II-III	Wabash Valley Fault

DATE	LOCALITY	MAGNITUDE	MAXIMUM INTENSITY	SOURCE ZONE
October 18, 2006	Lilborn, Missouri	3.4	IV	New Madrid Fault

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ANNEX G

DAM FAILURES

I. TYPE OF HAZARD

Dam Failures

II. DESCRIPTION OF HAZARD

Over the years dam failures have injured or killed thousands of people, and caused billions of dollars of property damage in the United States. Among the most catastrophic were the failures of the Teton Dam in Idaho in 1976, which killed 14 people and caused more than $1 billion in damage, and the Kelly-Barnes Dam in Georgia, which left 39 dead and $30 million in property damage. In the past few years, over 200 documented dam failures occurred nationwide causing four deaths and millions in property damage and repair costs. The problem of unsafe dams in Missouri was underscored by dam failures at Lawrenceton in 1968, Washington County in 1975, Fredricktown in 1977, and the December 14, 2005 collapse of the Upper Reservoir of AmerenUE's Taum Sauk hydroelectric complex in Reynolds County. Overall, many of Missouri's smaller dams are becoming a greater hazard as they continue to age and deteriorate. While hundreds of them need to be rehabilitated, lack of funding and questions of ownership loom as obstacles.

A dam is defined by the National Dam Safety Act as an artificial barrier that impounds or diverts water and (1) is more than 6 feet high and stores 50 acre feet or more, or (2) is 25 feet or more high and stores more than 15 acre feet. Based on this definition, there are over 80,000 dams in the United States. Over 95 percent of these dams are non-federal, with most being owned by state governments, municipalities, watershed districts, industries, lake associations, land developers, and private citizens. Dam owners have primary responsibility for the safe design, operation, and maintenance of their dams. They also have responsibility for providing early warning of problems at the dam, for developing an effective emergency action plan, and for coordinating that plan with local officials. The State has ultimate responsibility for public safety; many states regulate construction, modification, maintenance, and operation of dams, and also implement a dam safety program.

Dams can fail for many reasons. The most common are as follows:

1. Piping: Internal erosion caused by embankment leakage, foundation leakage and deterioration of pertinent structures appended to the dam

2. Erosion: Inadequate spillway capacity causing overtopping of the dam, flow erosion, and inadequate slope protection

3. Structural Failure: Caused by an earthquake, slope instability or faulty construction

These three types of failures are often interrelated. For example, erosion, either on the surface or internal, may weaken the dam and lead to structural failure, whereas a structural failure may shorten the seepage path and lead to a piping failure. Observable defects that provide good evidence of potential dam failures are illustrated in Section VII of this annex.

Dam construction varies widely throughout the state. Most dams are of earthen construction. Missouri's mining industry has produced numerous tailing dams for the surface disposal of mine waste. These dams are made from mining material deposited in slurry form in an impoundment. Other types of earthen dams are reinforced with a core of concrete or asphalt. The largest dams in the state are built of reinforced concrete and are used for hydroelectric power.

III. HISTORICAL STATISTICS

Missouri had some 4,100 recorded dams in July 2003, the largest number of man-made dams of any state in the United States. The topography of the state allows lakes to be built easily and inexpensively, which accounts for the high number. Despite such a large number, only about 620 Missouri dams (about 20 percent) fall under state regulations, while another 85 dams are federally controlled. A non-federal dam can be anything from a large farm pond (e.g., MFA Research Farm Lake Dam in Saline County, which is 20 feet high and holds back 60 acre feet of water) to Bagnell Dam, which created the Lake of the Ozarks. Most non-federal dams are privately owned structures built either for agricultural or recreational use. Missouri also has some 600 dams that were built as small watershed projects under Public Law-566 (Watershed Protection and Flood Prevention Act of 1953). These dams serve many functions, including flood control, erosion control, recreation, fish and wildlife habitat, water supply, and water quality improvement. Many of these PL-566 dams need ongoing maintenance to safely provide these functions. Another group of older dams in the state were originally built by railroad companies as holding ponds for water to be used in steam locomotives. Many of these are now used as drinking water reservoirs by nearby towns and cities.

Within the State of Missouri, the Department of Natural Resources Division of Geology and Land Survey maintains a Dam and Safety Program. The objective is to ensure that dams are safely constructed, operated, and maintained pursuant to Chapter 236 Revised Statutes of Missouri. Under that law, a dam must be 35 feet or higher to be state regulated. These dams are surveyed by state inspectors at least every 5 years. However, most Missouri dams are less than 35 feet high and thus, are not regulated. While the State has for many years encouraged dam owners to inspect those unregulated dams, the condition of some of these small structures may be inadequate.

IV. MEASURE OF PROBABILITY AND SEVERITY

Dams are generally classified in three categories that identify the potential hazard to life and property should a failure occur:

1. High Hazard: If the dam were to fail, lives would be lost and extensive property damage could result.

2. Significant Hazard: Failure could result in the loss of life and appreciable property damage.

3. Low Hazard: Failure results in only minimal property damage.

Table G-2 breaks down the number of dams by county and indicates the hazard potential classification of those dams in that county.

A. Status of Missouri Privately-Owned Dams

According to the MDNR 2003 Missouri Dam Database, 622 dams, or 15 percent of the dams surveyed, had a high hazard potential, while 992 dams, or 25 percent of the dams surveyed had a significant hazard potential. Another 2,402 dams, or 60 percent of the dams surveyed had a low hazard potential. However, many of Missouri's unregulated, private dams have gone unchecked for decades, according to Jim Alexander, chief engineer for MDNR's dam safety program. Dams that don't get regular attention can erode over the years, or be damaged by floods, he notes. "There are accidents out there waiting to happen." Some of the potential hazardous dams are 5 miles from a downstream city. If a dam fails, the owner is still responsible for damage, Alexander says, "but there's no legal handle on them to maintain the dams." Information collected from the Corps of Engineers 1980 National Inventory of Dams is outdated, and ownership of unregulated dams may have changed. Concern is mounting even for some of the state's regulated dams; particularly the Silver Creek Dam east of Rockaway Beach in Taney County, where the ownership is unknown. Erosion is eating away at the 40-foot-high dam, and the runoff creates silt deposits along the shore of Lake Taneycomo. One end of the dam is a barren clay bank that could give way during a heavy rainstorm, Alexander says. MDNR's plans were to obtain money through the State Legislature to repair the dam, and have the Attorney General's Office seek reimbursement from the owner when that person is identified.

B. Missouri's Small Watershed Projects with Dams

In 1954, Missouri built its first small watershed dam, and today has over 600 built under PL-566. These dams vary in size and perform multiple functions, including flood and erosion control. Many have a designed life of 50 years. According to a 1999 report, about 25 of these dams are more than 40 years old, and most will need major rehabilitation soon. More than 130 dams are 30 to 39 years old, while 182 of them are 20 to 29 years old (see Figure G-3, in Section VII).

The Iowa Watershed Task Force published a series of case studies in 1999 on aging watershed dams. The Missouri case study on the Tabo Creek Watershed Project in Lafayette County best illustrates the range of problems. The Tabo Creek project was authorized in 1960, with the first dam constructed in 1961. Since then, 64 grade-stabilization dams have been installed. Many of these dams now face the same problems that plague older dams in other watersheds approaching the end of their 50-year design life. They include deteriorating pipes and sediment filling the reservoirs. The most common problem is decaying pipes, since 44 of the dams were installed with corrugated metal pipes. One of the most visible problems is the lakes filling with sediment. The Lafayette County Soil and Water Conversation District is responsible for operation and maintenance, and performs annual inspections of each structure. However, the local sponsors don't have the funds needed to rehabilitate all the structures, which would cost an estimated $6 million, the case study notes. To date, no dams built under the Small Watershed Program anywhere in the U.S. have failed and resulted in loss of life or property. However, some exhibited significant problems that were corrected before a catastrophic failure or tragedy has occurred. The chances of such occurrences will undoubtedly increase, as the dams get older.

C. U.S. Army Corps of Engineers Operated Reservoir Dams in Missouri

The U.S. Army Corps of Engineers operates and maintains nearly a dozen large federally regulated reservoir dams in Missouri through its Kansas City, St. Louis, and Little Rock Districts. Extensive care is taken by the Corps in the design, construction, and operation of their dams. As a result, the Corps record for dam safety is considered excellent. Nevertheless, dam failures elsewhere in the country raise the possibility that any one of these facilities could fail. The threat

of an earthquake in some areas of the state, the possibility of sabotage or terrorist activities, or other natural or technological events are among the potential risk factors that could cause such a structure to fail.

For its regulated dams, the Corps Kansas City District began a program in1999 to revise its Contingency Plans for seven district dams it operates in Missouri. The plans were republished as emergency action plans, to provide an updated emergency notification/points of contact list in the event of a dam failure; to provide for increased communications with local emergency management officials; and to provide a more simplified format for clarity. The Corps Kansas City District worked jointly with the State Emergency Management Agency (SEMA), the National Weather Service, and local officials, including the county sheriff and emergency management coordinator in the affected counties (24 hours below stream). The plans were updated for Pomme de Terre Dam (Hickory and Benton counties); Blue Springs Dam (Jackson County); Longview Dam (Jackson County); Smithville Dam (Clay and Platte Counties); Long Branch Dam (Macon and Randolph Counties); Stockton Dam (Cedar and St. Clair Counties); and Truman Dam (Benton and Morgan Counties). Two other counties, Schuyler and Putnam, were included in an updated plan for the Corps' Rathbun Dam in Iowa.

The Corps St. Louis District maintains flood emergency plans for its Clarence Cannon Dam/Mark Twain Lake project, with the plan covering Ralls, Monroe, Pike and Shelby Counties; and Lake Wappapello Dam for Wayne, Butler, Stoddard and Dunklin Counties. The Corps Little Rock District has similar plans for Table Rock Dam, Taney and Ozark Counties; and for Clearwater Dam, Wayne, Butler, and Reynolds Counties. Figure G-4 shows the location of the Corps' Missouri reservoir dams by county, and adjacent counties that could be impacted (emergency notification) by a dam failure.

Missouri's percentage of high hazard dams in the MDNR inventory puts the State at about the national average for that category. However, the probability of dam failure increases as many of the smaller and privately-owned dams continue to deteriorate without the benefit of further regulation or improvements. Based on this information, the State rates the overall probability of dam failure as significant and the severity as moderate.

V. IMPACT OF THE HAZARD

When a dam fails, the stored water can be suddenly released and have catastrophic effects on life and property downstream. Homes, bridges, and roads can be demolished in minutes. The failure of the Buffalo Creek Dam in 1972 in West Virginia killed 125 people. The 2005 collapse of the Taum Sauk Upper Reservoir destroyed the house of the superintendent of DNR's Johnsons Shut-ins State Park in Reynolds County. The family of five was rescued by the Lesterville Volunteer Fire Department. DNR is depending on AmerenUE to provide the funds to restore the park to its original condition. At least 26 recorded dam failures have occurred in 20 Missouri counties since the turn of the 20th century. Fortunately, only one drowning has been associated with a dam failure in the state, and there has been little consequence to property.

Residents near a high or moderate hazard dam should become familiar with the dam's emergency action plans. Emergency plans written for dams include procedures for notification and coordination with local law enforcement and other governmental agencies, information on the potential inundation area, plans for warning and evacuation, and procedures for making emergency repairs.

VI. SYNOPSIS

Dam breaks are caused most often by failure of the structure itself. However, flooding is the most common hazard associated with dam failure. Prolonged rains and flooding can saturate earthen dams, for example, producing much the same breaching effect as occurs with earthen levees. Flooding can also result in overtopping of dams when the spillway and reservoir storage capacities are exceeded. A large slide may develop in either the upstream or downstream slope of the embankment and threaten to release the impounded water. Complete structural collapse can occur, especially as a result of an earthquake.

Actual dam failure can result not only in loss of life, but also considerable loss of capital investment, loss of income, and property damage. Loss of the reservoir itself can cause hardship for those dependent on it for their livelihood or water supply.

VII. MAPS OR OTHER ATTACHMENTS

Tables:

- Dams In Missouri By Purpose: Table G-1.
- Dams in Missouri by County and the Threat of Dam Failure in Each County: Table G-2.

Illustrations:

- Observable Defects: Figure G-1.
- Number of Dams By County: Figure G-2.
- Our Aging Dams – Survey of Small Watershed Dams (Missouri and national summaries): Figure G-3.
- Missouri Counties with Corps of Engineers Reservoir Dams: Figure G-4.

TABLE G-1

DAMS IN MISSOURI BY PURPOSE

Purpose	Number	Percent
Fire and Farm Ponds	381	10.8
Flood Control	285	8.0
Hydroelectric	8	0.2
Irrigation	296	8.4
Navigation	7	0.2
Recreation	1,826	51.6
Tailings and Others	487	13.8
Water Supply	243	6.9
Undetermined	8	0.1

TABLE G-2

DAMS IN MISSOURI BY COUNTY AND THE THREAT OF DAM FAILURE IN EACH COUNTY

County	Number of Dams	Hazard Potential Classification		
		High	Significant	Low
Adair	27	2	6	19
Andrew	22	4	7	11
Atchison	10	1	1	8
Audrain	85	5	23	57
Barry	1	0	0	1
Barton	31	0	4	27
Bates	23	2	7	14
Benton	25	3	5	17
Bollinger	27	4	8	15
Boone	123	28	26	69
Buchanan	29	5	8	16
Butler	30	1	8	21
Caldwell	18	1	4	13
Callaway	107	9	24	74
Camden	21	5	6	10
Cape Girardeau	29	12	4	13
Carroll	46	1	8	37
Carter	13	1	4	8
Cass	67	13	18	35
Cedar	11	1	1	9
Chariton	24	1	2	21
Christian	4	0	1	3
Clark	33	2	3	28

TABLE G-2 (Continued)

DAMS IN MISSOURI BY COUNTY AND THE THREAT OF DAM FAILURE IN EACH COUNTY

County	Number of Dams	Hazard Potential Classification		
		High	Significant	Low
Clay	36	9	10	17
Clinton	25	1	7	17
Cole	30	5	15	10
Cooper	22	0	2	20
Crawford	76	8	21	47
Dade	11	0	1	10
Dallas	4	0	1	3
DeKalb	60	2	17	41
Dent	36	6	10	20
Douglas	5	0	2	3
Dunklin	2	1	1	0
Franklin	137	22	32	83
Gasconade	80	8	14	58
Gentry	19	1	4	14
Greene	18	10	3	5
Grundy	36	4	6	26
Harrison	112	2	44	64
Henry	39	0	6	33
Hickory	7	1	1	5
Holt	18	3	4	11
Howard	33	5	2	25
Howell	24	2	7	15
Iron	41	14	8	19
Jackson	77	27	18	32
Jasper	14	2	3	9
Jefferson	149	60	48	41
Johnson	92	10	14	68
Knox	21	0	6	15
Laclede	18	0	7	11
Lafayette	187	2	41	144
Lawrence	7	0	0	7
Lewis	67	0	16	51
Lincoln	67	7	23	37
Linn	17	2	6	9
Livingston	59	1	16	42
McDonald	3	1	0	2
Macon	24	3	3	18
Madison	24	12	8	4
Maries	29	0	7	22

TABLE G-2 (Continued)

DAMS IN MISSOURI BY COUNTY AND THE THREAT OF DAM FAILURE IN EACH COUNTY

County	Number of Dams	Hazard Potential Classification		
		High	Significant	Low
Marion	21	1	4	16
Miller	14	4	4	6
Mississippi	3	0	0	3
Moniteau	19	2	4	13
Monroe	24	2	5	17
Montgomery	84	10	18	55
Morgan	12	0	2	10
New Madrid	1	0	0	1
Newton	15	6	4	5
Nodaway	52	1	12	39
Oregon	9	2	1	6
Osage	21	3	10	8
Ozark	7	1	4	2
Pemiscot	3	0	0	3
Perry	32	12	7	13
Pettis	28	3	4	21
Phelps	29	4	8	17
Pike	46	2	16	28
Platte	26	7	8	10
Polk	13	0	2	11
Pulaski	14	0	0	14
Putnam	17	0	5	12
Ralls	29	5	8	16
Randolph	45	3	9	32
Ray	38	10	9	19
Reynolds	22	12	2	8
Ripley	24	0	8	16
St. Charles	113	19	28	65
St. Clair	15	0	1	14
St. Francois	63	20	23	20
Ste. Genevieve	50	18	16	16
St. Louis	42	22	14	6
St. Louis City	1	0	1	0
Saline	23	2	4	17
Scotland	22	3	2	17
Scott	16	3	2	11
Shannon	9	1	3	5
Shelby	23	2	5	16
Stoddard	26	8	5	13

TABLE G-2 (Continued)

DAMS IN MISSOURI BY COUNTY AND THE THREAT OF DAM FAILURE IN EACH COUNTY

County	Number of Dams	Hazard Potential Classification		
		High	Significant	Low
Stone	1	1	0	0
Sullivan	40	1	7	32
Taney	7	3	1	3
Texas	6	0	2	4
Vernon	43	1	5	37
Warren	125	28	46	51
Washington	119	51	34	34
Wayne	34	15	9	10
Webster	19	1	9	9
Worth	35	1	3	31
Wright	12	0	6	6

FIGURE G-1

OBSERVABLE DEFECTS

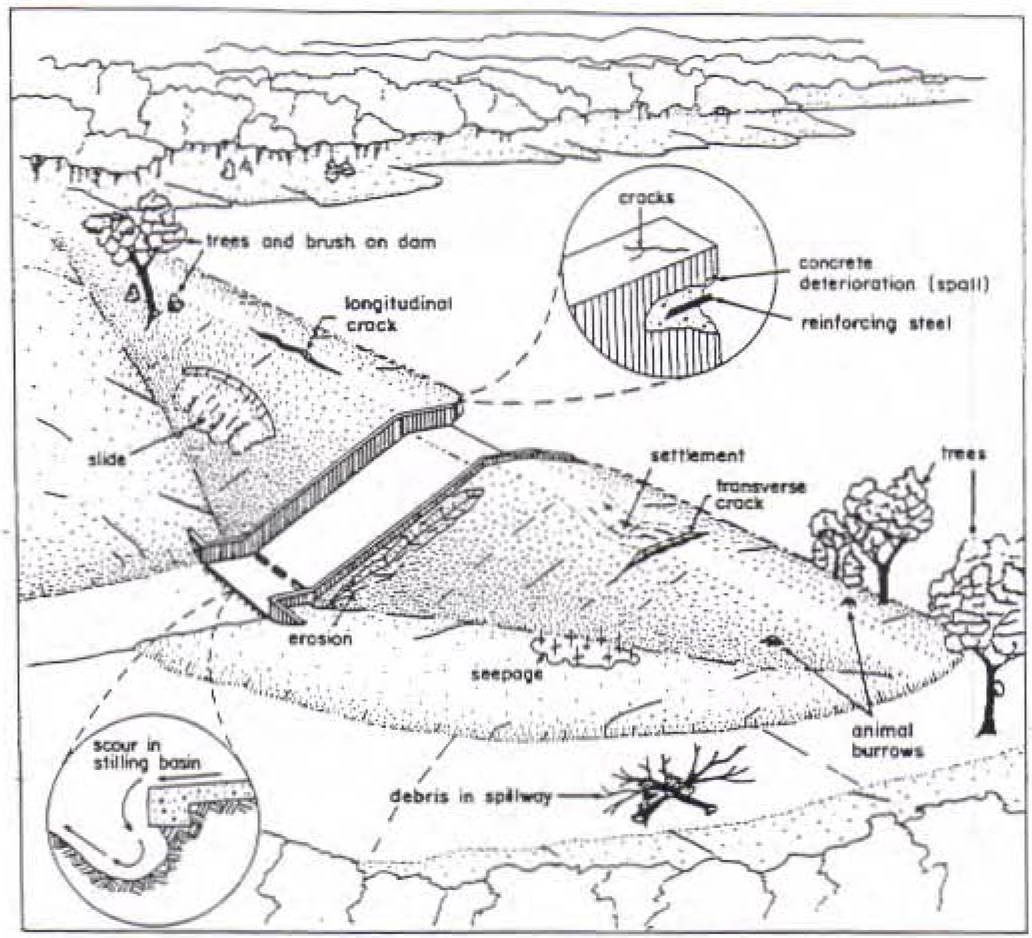
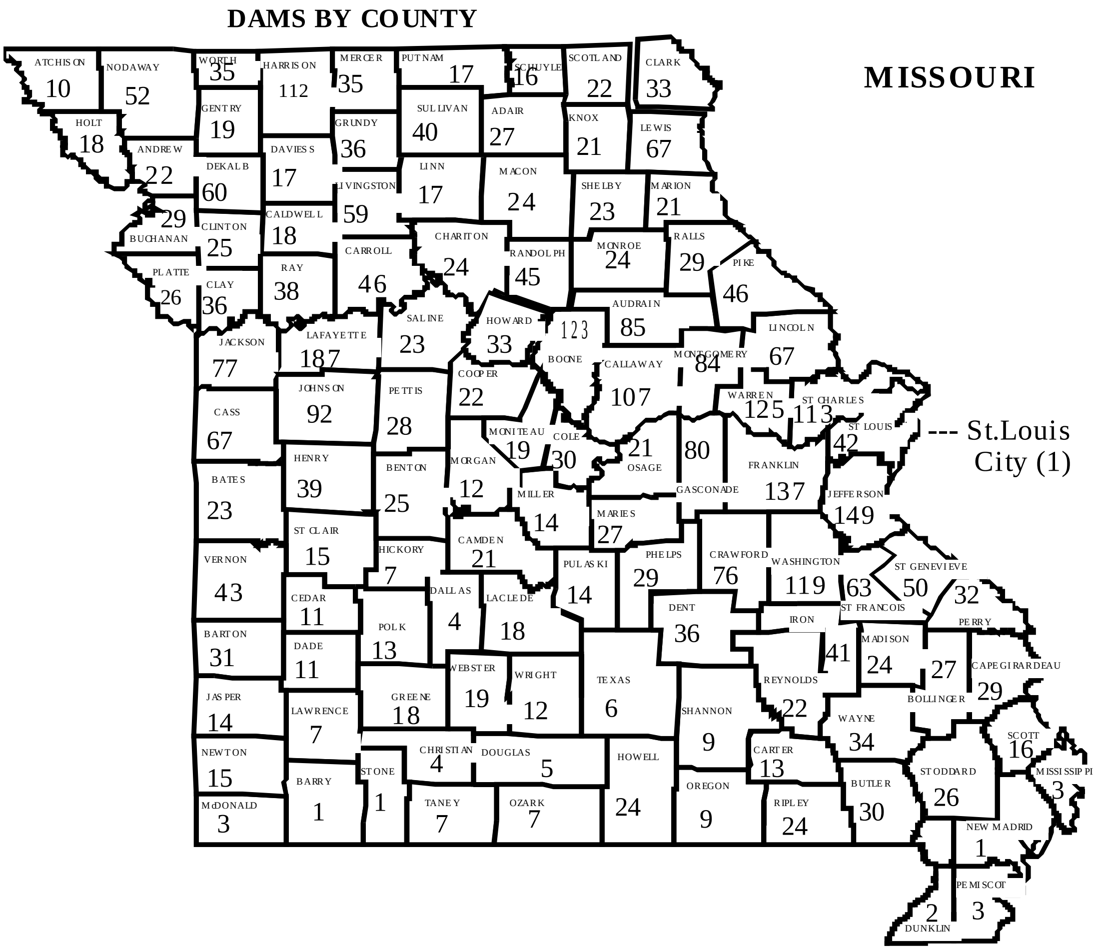


FIGURE G-2

NUMBER OF DAMS BY COUNTY

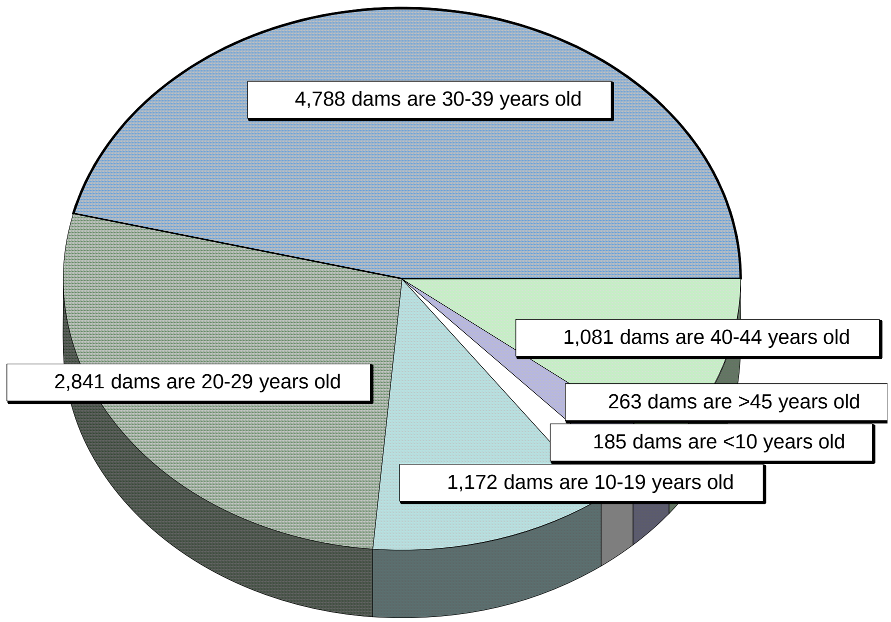


Source: Inventory of Dams, Department of Natural Resources, Division of Dam Safety

FIGURE G-3

OUR AGING DAMS
SURVEY OF SMALL WATERSHED DAMS

NATIONWIDE



MISSOURI

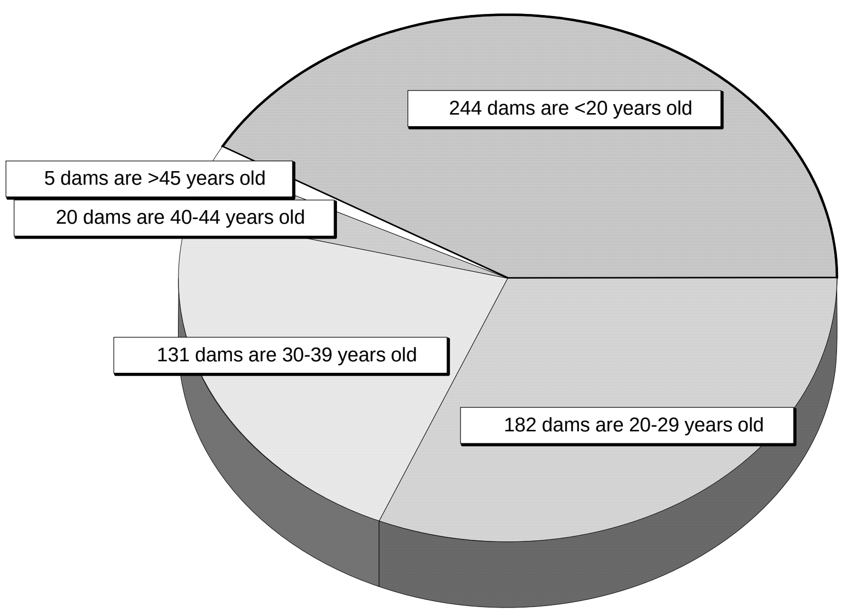
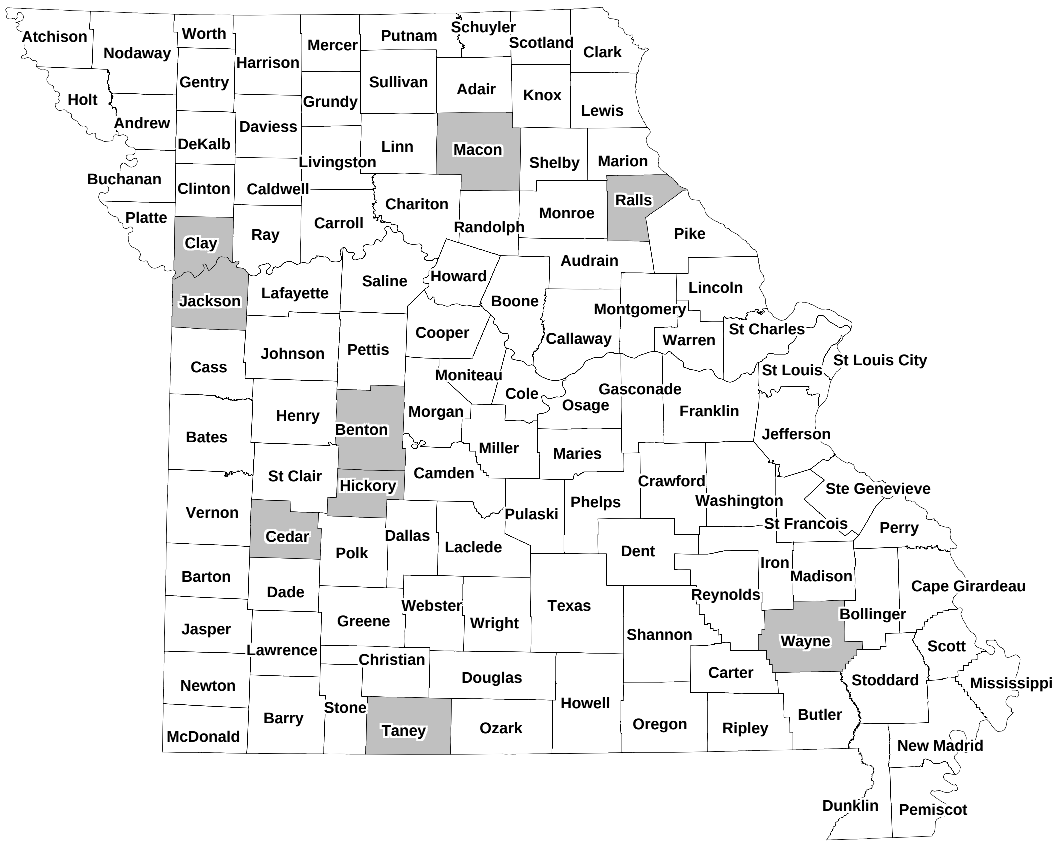


FIGURE G-4

MISSOURI COUNTIES WITH CORPS OF ENGINEERS RESERVOIR DAMS



In the event of a dam failure, emergency warning/notification procedures are provided in both Corps of Engineers flood emergency plans and local county emergency operations plans to alert local officials in the threatened areas. Emergency notification includes the county in which the dam is located, and adjacent/nearby counties below stream that may also be impacted. The Corps maintains such emergency plans for each individual dam, and copies are kept on file with the State Emergency Management Agency.

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U.S. Army Corps of Engineers

ANNEX H

UTILITIES
(INTERRUPTIONS AND SYSTEM FAILURES)

I. TYPE OF HAZARD

Utilities—Interruptions and System Failures

II. DESCRIPTION OF HAZARD

Utility interruptions and failures may involve electrical power, natural gas, public water and communications systems. All of these systems or a combination of these utility systems exist virtually throughout the state. Many utilities are localized and serve only one community, while other utilities serve a regional area. Utilities are often dispersed over a wide area, and many have facilities located throughout their service area. For example, many electric companies have multiple generating facilities, which can redistribute power via transmission lines as they are connected to load stations. Therefore, power can be redistributed, if needed, so that power is lost to as limited an area as possible. Many water companies have some type of back-up systems, such as water impoundments, other deep wells or hook-up arrangements with other water companies. Similar switching and rerouting capabilities may exist with communications and natural gas utilities. Utility systems exist everywhere and are subject to damage from digging, fire, traffic accidents, and severe weather, including flooding and other day-to-day events. Many utilities utilize emergency batteries or generators to provide back-up power for high priority equipment.

III. HISTORICAL STATISTICS

Because utilities exist everywhere in the state, damage to utilities may occur frequently. This may be due to a backhoe cutting a buried line, an accident involving a motor vehicle, a flood or other severe weather. Many of these interruptions or failures go unreported to the Public Service Commission (PSC), and no definitive reporting system exists. Therefore, limited statistical information is available.

During the flood of 1993, telecommunications companies proved their adaptability by using cellular service to replace wire line service in areas where service could not be restored in a timely manner. One Local Exchange Company (LEC) utilized a trailer with cellular pay phones where the land lines were interrupted. Another company temporarily replaced analog subscriber carrier service with site-based cellular service. Short-haul portable microwave was also utilized to replace copper lines lost during the flood.

On January 30, 2002, a severe ice storm struck portions of western and northern Missouri, leaving devastation and darkened homes and businesses. Many news articles referred to this ice storm as the worst in Missouri's history. During the ice storm, ice accumulated on any object that was at or below freezing, and the weight of the ice broke utility poles, conductors, tree limbs and other objects that could not withstand the weight of the ice. Ice accumulations over an inch were reported in many areas. Many tree branches could not withstand the added weight of the ice and fell to the ground, striking whatever was in their path. Cars, homes, streets, properties, and electric power facilities were recipients of the falling trees and limbs. When the ice began to melt, the falling ice caused additional outages. Some electric customers experienced outages more than once during that period, as power was restored but

interrupted again by falling limbs. At the peak of outages, over 400,000 customers were without power. Within three days, most of these customers were returned to service, but many customers in more heavily damaged areas were without power for over a week. Utilities affected by the ice storm quickly mobilized all of their available crews and sought outside assistance. Work crews from 16 different states came to western Missouri in an effort to rapidly restore power to as many customers as possible. On July 19-20, 2006, severe storms with high winds and possible tornado activity struck St. Louis and the counties of St. Louis, Dent, Iron, Jefferson, St. Charles, and Washington. As a result of the storms approximately 500,000 Ameren UE customers were without electrical power. Over 3600 utility workers from Ameren UE and outlying utility company's were involved in restoration efforts, the largest in company history. High priority projects included restoring power to 14 nursing homes, cooling stations, hospitals, city services and utilities and fuel terminals. Compounding the problems, a heat advisory with heat index values as high as 104 degrees plagued recovery efforts for several weeks following the event. For additional information about severe winter weather in Missouri, see Section C of this Hazard Analysis Plan.

IV. MEASURE OF PROBABILITY AND SEVERITY

Because utilities exist throughout the state and are vulnerable to interruptions or failures, there is a high probability that this hazard may occur at anytime or anyplace throughout the state. In many cases, these are small isolated events, well within the capabilities of the local utility to address. Therefore, the degree of severity of these day-to-day events may be considered low. Due to long-range planning, regulation, and diligence of the utility operators, major interruptions resulting in a high degree of severity are few and far between. Recent regulatory, planning and structural initiatives designed to minimize interruptions and failures are listed below.

V. IMPACT OF THE HAZARD

Utility outages and interruptions can be very localized, or region-wide. Their greatest impact is generally upon the very young or elderly, who can be expected to have greater health risks associated with resultant loss of heating/cooling systems and with the loss of medical equipment that requires a power source. Loss of communications can also adversely affect the provision of emergency services, making it difficult to contact the services for emergency assistance. In addition, utility outages can cause significant problems within the financial community, should there be a long-term loss of their data communications.

A. Communications

During 1990, the Telecommunications Staff of the PSC requested that LECs submit plans for disaster recovery. Every LEC in the state submitted a plan that lists practices and procedures for any kind of disasters whether natural or man-made. The PSC has recommended to the telecommunication industry that in the event of an emergency, the various companies and emergency agencies should coordinate a single point of contact for emergency situations.

In order to mitigate the damage of earthquakes or other disasters, the LECs added bracing to all their central offices for their switching equipment and batteries. Since earthquakes or other disasters may affect electrical service, which is essential for operations, many companies have obtained on-site generators or made contingency arrangements to acquire them in a disaster. For additional information regarding earthquakes in Missouri, see to Section F of this Hazard Analysis Plan. Such generators would be needed prior to exhaustion of emergency battery supplies, which may last about 8 hours. During the flood of 1993, one LEC provided emergency power to a central office, which was isolated by flood waters. This was accomplished by driving

a flat bed truck through the water with a diesel generator mounted on the bed. The generator was fueled by boat.

Vulnerability of buried telecommunication cables has always been a problem. Cables may be subject to accidental or intentional cuts. However, legislation and mitigation procedures have been taken to prevent such events. Senate Bill Numbers 214 and 264 provided for the existence of a company called “One Call”, which locates and marks buried utilities. Currently, most LECs in the state have their facilities on record with the “One Call” agency. Anyone planning any subsurface digging, drilling, or plowing of any kind is advised and encouraged to use the “One Call” service. Additional steps to prevent cutting of buried telecommunication cables include clearly marking cable routes with above ground pedestals and poles, as well as patrolling the routes by vehicle and air. In addition to these precautions, most companies are presently building fiber rings for the fiber optic routes, to protect continuity of service in the event of an accidental cut.

Since floods pose a threat to telephone service, most companies with buried cables in floodplains are replacing conventional telephone pedestals with flood resistant telephone pedestals, which protect the cables during floods of short duration. For additional information on flooding in Missouri, see to Section B of this Hazard Analysis Plan.

B. Electrical Service

Electrical utilities in Missouri prepare for disasters and power outages by developing written plans to follow when abnormal events cause extensive outages to customers. Power outages caused by severe weather have prompted the creation of tree trimming plans to ensure above ground power lines are free of potential limbs that could fall on power lines and cause interruptions of power if knocked down. In addition, ongoing review of emergency plans and training for such events have been implemented. During the 2002 ice storm that struck western and northern Missouri, many customers were unable to contact affected utilities by telephone because there were not enough utility representatives to respond to all customer calls. Therefore, an automated system was developed to allow customers to input information to the computer that will automatically generate work orders for service calls. The PSC also advised utility companies to provide feedback to customers that their outage was recorded, to convey assurance that their outage report has been received.

C. Natural Gas

All natural gas system operators in the state operate under the jurisdiction of the PSC. These operators must comply with the Commission's Pipeline Safety Regulations, which include emergency response procedures to pipeline emergencies and natural disasters. Natural gas system operators have plans on file with the PSC. Part of these plans include indexes of utilities and their locations in the state.

In 1989, House Bill 938 provided the Commission with additional legal power to enforce the Pipeline Safety Regulations. In 1990, due in part to the Iben Browning earthquake projection, all utilities were mandated by the Commission to develop natural disaster plans (to include potential impacts of earthquakes) and file the plans with the Commission. The Commission also developed its own plan to respond to a disaster causing an interruption or failure of a utility service. The Iben Browning earthquake projection created a new awareness for the necessity for such disaster response and recovery plans. Several natural gas companies have since stored emergency equipment and survival rations in protected locations. This also resulted in a new

demand for excess flow and motion sensing valves on natural gas service lines. Operators also reviewed, updated or increased their mutual aid agreements with other utilities and contractors.

In 1990, Senate Bill numbers 214 and 264 required all owners and operators of underground pipeline facilities to participate in the Missouri "One Call" notification center. These bills altered the original Chapter 319 Damage Prevention Act and added a penalty clause. This participation provides for the location of underground pipelines after notification by the excavator and before any excavation work begins.

VI. SYNOPSIS

Utility companies are generally well prepared to deal with day-to-day outages. The earthquake threat to statewide and multi-states utilities is the greatest concern to the integrity and operability of Missouri's utilities. Planning, regulation, mitigation and mutual aid are all just a few tools available to reduce, speed recovery and prevent utility interruptions and failures.

VII. MAPS OR OTHER ATTACHMENTS

An earthquake map showing all pipelines and electrical transmission lines is on file with the State Emergency Management Agency’s, Earthquake Section. Attachments to this section include the following figures:

- Electrical Cooperatives in Missouri: Figure H-1
- Major Interstate Natural Gas Pipelines in Missouri: Figure H-2.

FIGURE H-1

ELECTRICAL COOPERATIVES IN MISSOURI

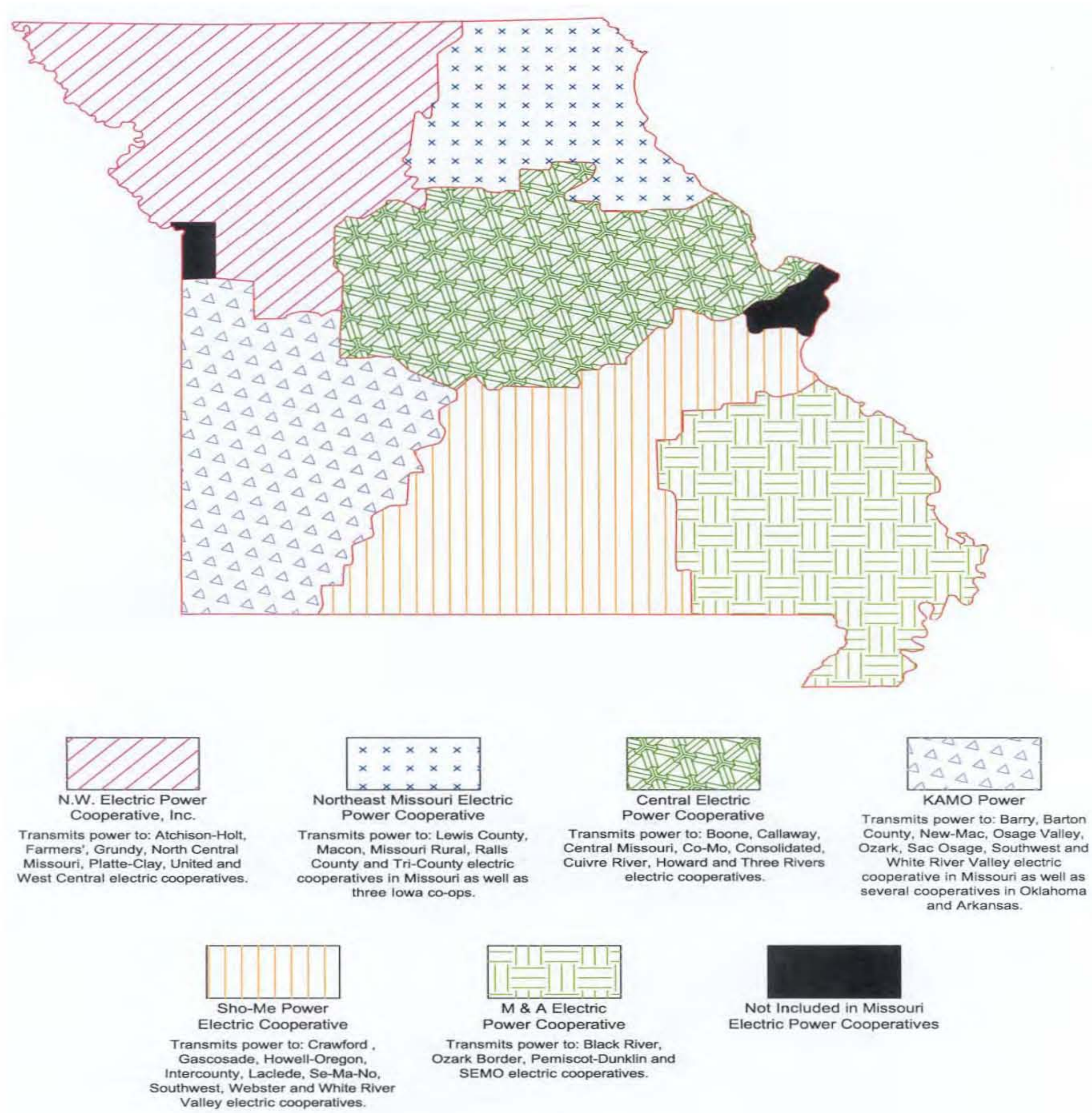

FIGURE H-2

MISSOURI PIPELINES

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ANNEX I

FIRES
(STRUCTURAL, URBAN, AND WILD)

I. TYPE OF HAZARD

Fires (Structural, Urban, and Wild)

II. DESCRIPTION OF HAZARD

Fires can range in scope to include structural, urban, and wild fires. For the purpose of this analysis, structural and urban fires are considered in one category, with wild fires, including forest, prairie, and grassland locations, considered separately.

Structural fires are a major problem that can affect any area of the state. The Missouri Division of Fire Safety (MDFS) indicates that approximately 80 percent of the fire departments in Missouri are staffed with volunteers dedicated to the task of fire prevention and suppression. Whether paid or volunteer, these departments are often limited by lack of resources and financial assistance. The impact of a fire to a single-story building in a small community may be as great as that of a larger fire to a multi-story building in a large city.

Because fires can occur anywhere in the state, the MDFS continues to actively promote the enactment of a statewide fire code. Although no statewide code has been enacted to date, successful legislative efforts to improve fire safety have included the following:

1. Fire, Safety, Health, and Sanitation Inspections of Child Care Facilities (RSMo 210.252)
2. Boiler and Pressure Vessel Safety Act (RSMo 650.200)
3. Elevator Safety Act (RSMo 701.350).
4. Fireworks Safety Act (RSMo 320-111)
5. Amusement Ride Safety Act (RSMo 316.200-211)

Fires impact many aspects of society in terms of economic, social, and other indirect costs. According to the MDFS, the most costly crime in the state is arson. This should be a great concern to citizens, law enforcement, the judicial system, and the fire service sector. Fires caused by arson impact citizens through higher insurance premiums, lost jobs, loss of lives, injuries, and property loss. Primary duties of the Missouri State Fire Marshal include the investigation of fires, explosions, and any related occurrences. The investigative staff is responsible for investigating any fire requested by fire service and law enforcement within the state. This also includes explosions, bombings, and all other related offenses.

Presently, the MDFS investigative staff includes 1 deputy chief, 2 regional chiefs and 16 field investigators. This staff must cover all 114 counties and is dedicated to assisting any local or state agency and conducting quality investigations. The investigators are trained in several fields of expertise, including arson for fraud, explosives recognition, and post-blast training. The Division uses two canines

specifically trained in explosives detection. Another tool utilized by the investigation unit is the Computerized Voice Stress Analyzer (CVSA).

The MDFS Training Unit develops and oversees the training curriculum being provided regionally for state certification of fire fighters, fire investigators, fire inspectors, and fire service instructors. Although fire fighter certification is not mandatory in Missouri, currently over 48,000 individuals are certified by the MDFS.

Also, the MDFS has initiated a statewide mutual aid system. This system enhances the ability of rural (volunteer) or city (paid) fire departments to handle major fires or incidents within their jurisdictions. To compliment the statewide mutual aid system, an incident management system (IMS) overhead team concept has been developed throughout the state. This should assist the rural and city fire departments in the management of a major fires, and man-made or natural disasters. Figure I-1 shows the Fire/Rescue Mutual Aid Regions in Missouri.

The MDFS is responsible for the enforcement of fireworks laws throughout Missouri. In addition to conducting inspections of any facilities involved with fireworks, approximately 1,513 permits are issued yearly to manufacturers, wholesalers, and retailers of fireworks. Persons conducting public fireworks shows are required to obtain a fireworks operator license issued by MDFS. Illegal fireworks are a concern because they can be dangerous, causing loss of lives, severe injuries, and property damage.

The Forestry Division of the Missouri Department of Conservation (MDC) is responsible for protecting privately-owned and state-owned forests and grasslands from the destructive effects of wildfires. To accomplish this task, eight forestry districts have been established in the state to assist with the quick suppression of fires (see Figure I-2). The Forestry Division works closely with Volunteer Fire Departments and Federal partners to assist with fire suppression activities. Currently, more than 900 rural fire departments have mutual aid agreements with the Forestry Division to obtain assistance in wildfire protection if needed; a cooperative agreement with the Mark Twain National Forest is renewed annually. Figure I-3 illustrates the 12 Mark Twain National Forests across Missouri.

Forest and grassland fires can occur any day throughout the year. Each year, an average of about 3,700 wildfires burn more than 55,000 acres of forest and grassland in Missouri. Most of the fires occur during the spring season, normally between February 15 and May 10. The length and severity of burning periods largely depend on the weather conditions. Spring in Missouri is noted for its low humidity and high winds. These conditions, together with below-normal precipitation and high temperatures, result in extremely high fire danger. In addition, due to the continued lack of moisture throughout many areas of the state, conditions are likely to increase the risk of wildfires. Drought conditions can also hamper fire-fighting efforts, as decreasing water supplies may not provide for adequate fire fighting suppression. Spring is when many rural residents burn their garden spots, brush piles, and other areas. Many landowners also believe it is necessary to burn their forests in the spring to promote grass growth, kill ticks, and reduce brush. Therefore, with the possibility of extremely high fire dangers and the increased opportunities for fires, the spring months are the most dangerous for wildfires. The second most critical period of the year is fall. Depending on the weather conditions, a sizeable number of fires may occur between mid-October and late November.

III. HISTORICAL STATISTICS

Because buildings exist anywhere people live and work, fires can occur at anytime and anyplace throughout the state. The frequency of structural fires depends on a wide range of factors. These factors include, but are not limited to population or building density, building use, lack of fire codes, lack of

enforcement when fire codes exist, fire safety practices (or lack thereof) by building occupants, lack of adequately equipped fire departments, and criminal intent related to arson.

Data on the frequency of structural fires is included in the National Fire Incident Reporting System Statistics (NFIRS) data provided by the MDFS (See Table I-1 below). However, according to the MDFS, almost 731 of approximately 896 fire departments have reported data used to compile the NFIRS. Without 100% reporting, definitive conclusions are not possible; however, fire departments, law enforcement offices and other agencies spend considerable manpower and funding to respond to and investigate structural fires.

TABLE I-1

Year	Total Fires	Total Fire Dollar Loss	Fire Related Injuries	Fire Related Deaths
2002	19,749	$ 80,184,764	225	39
2003	22,097	$ 68,193,344	272	48
2004	30,731	$103,699,511	371	86
2005	24,182	$ 99,120,053	319	51

The Forest Division of the MDC is responsible for protecting the privately-owned and state-owned forests and grasslands from wildfires. To accomplish this task, eight forestry districts have been established. At the present time, the forestry districts afford intensive fire protection to approximately one-half of the state, or about 16 million acres. Within these districts, fairly accurate forest and grassland fire statistics are available from the MDC. In a typical year, approximately 3,700 wildfires occur. In 2005, 1,610 wildfires occurred in Missouri, burning 38,921 acres. Debris burning (fires resulting from land clearing, burning trash, range, stubble, right-of-way, logging slash, etc.) is the major cause of forest and grass fires in Missouri. Incendiary fires (fires willfully set by anyone on property not owned or controlled by him, and without the consent of the owner) continue to rank second in the number of wildfires that occur each year.

Table I-2 below lists the number and causes of forest and grassland fires in 2005 and the acres burned. Table I-3 shows the number of fires and acreage burned by forest and grassland fires yearly from 1993 to 2005.

TABLE I-2

2005 STATEWIDE FIRES BY CAUSE

Cause	Number	Acres	% Number	% Acres
Lightning	4	269.9	0.2 %	0.7 %
Campfire	13	1,018	0.8 %	2.6 %
Smoking	21	197.85	1.3 %	0.5 %
Debris	933	14,072.94	58.0 %	36.2 %
Arson	214	12,128.67	13.3 %	31.2 %
Equipment	51	675.3	3.2 %	1.7 %
Railroad	2	42.99	0.1 %	0.1 %
Children	10	70.7	0.6 %	0.2 %
Miscellaneous	362	10,444.78	22.5 %	26.8 %
TOTAL	1,610	38,921.13	100 %	100 %

In north and west-central Missouri, the MDC has limited firefighting forces. Forestry Division personnel, however, provide training and limited federal excess equipment to the many volunteer rural fire departments. See Figure I-2 for a map of the MDC forestry districts.

TABLE I-3

STATEWIDE FIRES AND ACRES BURNED

Year	Fires	Acres
1993	2,994	31,952
1994	2,748	51,896
1995	2,910	48,907
1996	3,793	88,933
1997	2,487	29,557
1998	1,112	10,415
1999	1,348	18,270
2000	4,910	132,718
2001	2,972	41,092
2002	2,376	54,397
2003	2,378	47,692
2004	2,917	55,732
2005	1,610	38,921

IV. MEASURE OF PROBABILITY AND SEVERITY

Even with the limited data in the NFIRS statistics, the probability of structural fires is quite high. Total monetary loss in 2005 according to the NFIRS, was over $103 million. In addition, there were 51 fire-related deaths in Missouri during 2005. Therefore, severity could be considered moderate.

The probability of wildfires (forest, prairie, and grassland) is considered moderate overall, but may increase to high during certain periods such as spring or late fall, or under conditions of excessive heat, dryness, or drought. The severity would be considered low to moderate.

V. IMPACT OF THE HAZARD

Structural and urban fires are a daily occurrence throughout the state. Approximately 100 fatalities occur annually, as well as numerous injuries affecting the lives of the victims, their families, and many others—especially those involved in fire and medical services. Unlike other disasters, structural fires are often insidious and despicable due to the prevalence of arson. All citizens pay the costs of arson whether through increased insurance rates, higher costs to maintain fire and medical services, or the costs of supporting the criminal justice system.

VI. SYNOPSIS

With sufficient mutual aid, local fire services have adequate day-to-day fire service capabilities. The greatest risk of interaction by fires with other hazards may involve damaging earthquakes. In these circumstances, the possibility of numerous fires and reduced firefighting capabilities would greatly increase the severity of structural fires.

VII. MAPS OR OTHER ATTACHMENTS

- Fire/Rescue Mutual Aid Regions: Figure I-1
- Missouri Department of Conservation Forestry Districts: Figure I-2
- Mark Twain National Forests: Figure I-3.

FIGURE I-1

MISSOURI FIRE AND MUTUAL AID REGIONS

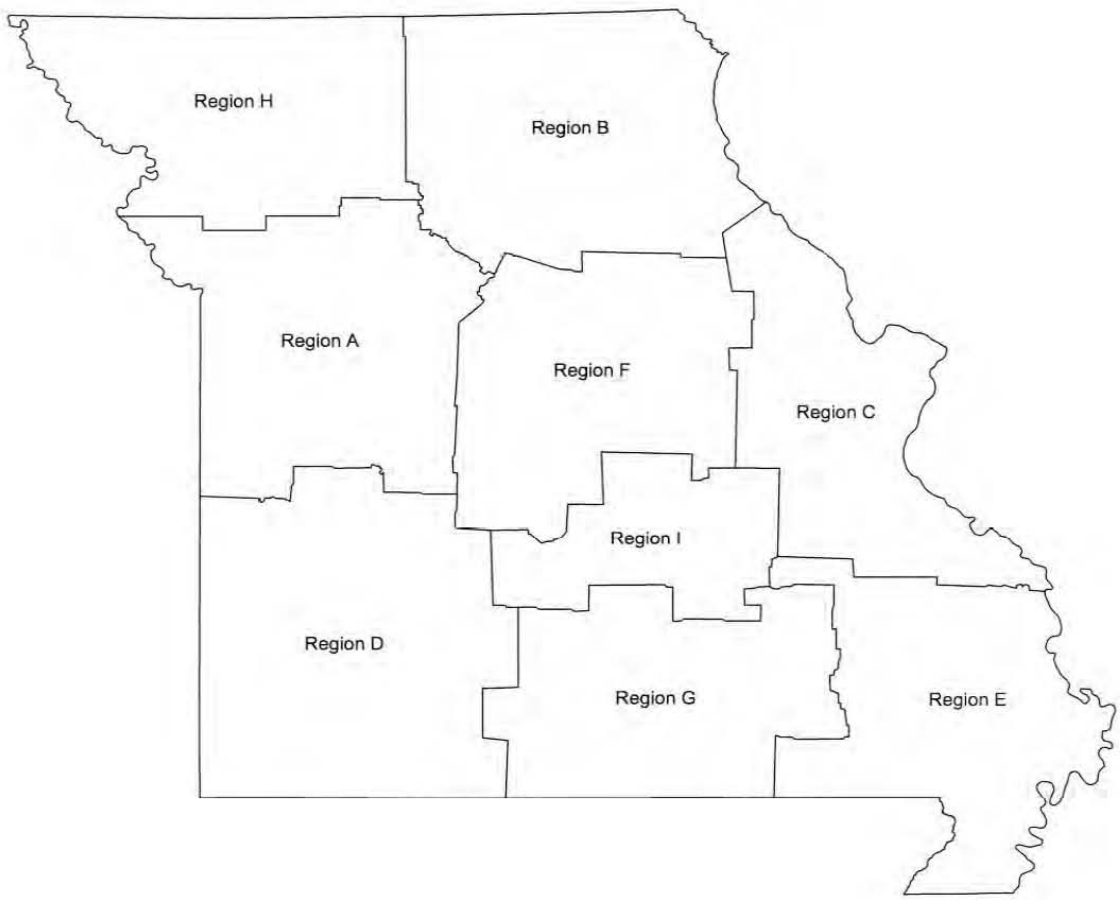

FIGURE I-2

MISSOURI DEPARTMENT OF CONSERVATION FORESTRY DISTRICTS

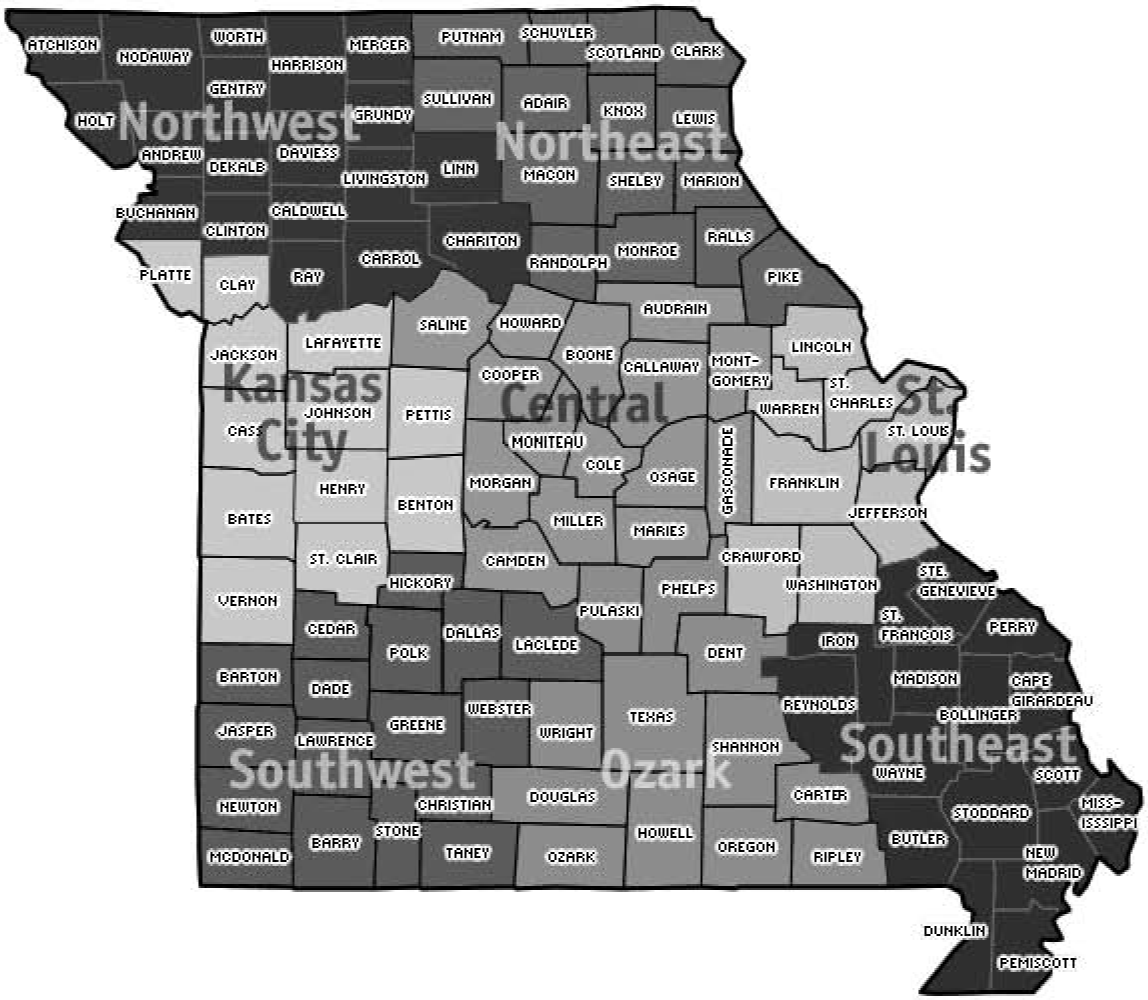

FIGURE I-3

MARK TWAIN NATIONAL FORESTS

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ANNEX J

NUCLEAR POWER PLANTS
(FIXED NUCLEAR FACILITIES)

I. TYPE OF HAZARD

Nuclear Power Plants (Fixed Nuclear Facilities)

II. DESCRIPTION OF HAZARD

There are presently four fixed nuclear facilities or reactors that under extreme circumstances and conditions could pose a threat to citizens of Missouri. These four reactors fall into two categories: research reactors and commercial nuclear power reactors. The first category, research reactors, represent a hazard only to personnel or others on site at the facility. Therefore, these reactors are not included in state radiological plans involving off-site emergency preparedness. For the second category, commercial nuclear power reactors, a worst-case scenario involving a significant release of radioactive material could force the evacuation of the general population within a 10-mile radius of the facility. A release of this magnitude could also contaminate food and water sources within a 50-mile radius.

The magnitude of releases from nuclear plant sites vary depending on the nature of the accident type, reactor design, and meteorological conditions during the release. The Nuclear Regulatory Commission (NRC) and Federal Emergency Management Agency (FEMA) have developed regulatory guidance that both the state and utility must meet to protect the health and safety of the general population within the 10-mile Emergency Planning Zone (EPZ). Four classes of Emergency Action Levels are used for early notification of incidents, with clear instructions for emergency organizations within the EPZ. The four emergency classifications listed in progression of severity are notification of unusual event, alert, site area emergency, and general emergency. These levels are discussed below.

A. Notification of Unusual Event

This classification describes unusual events that are in process or have occurred and indicates a potential degradation of the safety level of the plant. No releases of radioactive material requiring off-site response or monitoring are expected unless safety systems are further degraded.

B. Alert

This classification describes unusual events that are in process or have occurred and indicate a potential degradation of the level of plant safety. Any releases are expected to be limited to small fractions of the Environmental Protection Agency (EPA) Protective Action Guideline (PAG) exposure levels.

C. Site Area Emergency

This classification level describes events in process or having occurred that involve actual or likely major failures of the plant functions needed to protect the public. No releases are expected to exceed EPA PAG exposure levels except near the site boundary.

D. General Emergency

This classification describes an event in process or having occurred that involves actual or imminent substantial core degradation or melting, with the potential for loss of containment integrity. Releases can reasonably be expected to exceed the EPA PAG exposure levels off-site for more than the immediate site area.

III. HISTORICAL STATISTICS

A. Research Reactors

Two research reactors are located in the State of Missouri: the University of Missouri-Rolla Reactor (UMRR) and the University of Missouri Research Reactor (MURR). The maximum hypothetical accident from either research reactor would place at risk only personnel working at the facilities or the public within the site boundary of the respective facilities. Both research reactors have emergency plans approved by the Nuclear Regulatory Commission (NRC) that conform with regulatory requirements in 10 CFR 50, Appendix E, and follow the guidance provided by Revision I to NRC Regulatory Guide 2.6, Emergency Planning for Research and Test Reactors, March 1982, and ANSI/ANS-15.16, Emergency Planning for Research and Test Research Reactors, November 29, 1981.

B. UMRR

UMRR is a water-moderated pool-type reactor licensed to operate at 200 KW. The UMRR is used for training and research purposes. Because the reactor is mainly used for training, it is not operated for long periods of time. The reactor is located on the east side of the Rolla campus near 14th Street and Pine Street in Rolla, Missouri. Due to the low power of licensing (200 KW), prevailing standards and guidelines do not require the establishment of an emergency planning zone. Therefore, no classification higher than a Site Area Emergency has been included in the UMRR emergency plans. The UMRR has been in operation since December 1961 and has never had an incident that would be considered an emergency action level.

C. MURR

MURR is a 10 MW pressurized water-moderated pool-type reactor with a containment building. The MURR is used to provide research, training, and services to the four campuses of the University of Missouri system, other universities, government agencies, and private industry as well. The reactor is located on a 550-acre tract of land south of the University of Missouri-Columbia campus on Providence Road. The MURR has an emergency planning zone encompassing the area within a 100-meter radius from the exhaust stack. No credible potential accidents have been identified for the MURR facility that would result in exceeding the classification of Notification of Unusual Events. As a result, no classification higher than a Site Area Emergency is included in the emergency plan for the MURR. The MURR has been in operation since October 1967. The reactor averages 8,060 hours of operation per year (155 hours per week) at peak flux due to the service work that it performs. During its history of operation, the MURR has never had an incident that would be considered an emergency action level.

D. Commercial Nuclear Power Reactors

Two commercial nuclear power reactors could have an impact on the health and safety of Missouri citizens. These reactors are the Callaway Nuclear Plant and the Cooper Nuclear Station, both of which are used for electrical power generation. Both utilities have emergency plans that conform to NUREG-0654, FEMA-REP-1 Rev.1, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants. The utilities and the state are required to demonstrate annually various elements of preparedness through radiological emergency drills evaluated by inspectors representing the Federal Emergency Management Agency (FEMA) and the NRC.

E. Callaway Nuclear Plant

The Callaway Plant consists of one unit with a pressurized water reactor capable of providing 1150 megawatts of electricity. The plant is located in Callaway County, Missouri, and is owned and operated by Ameren UE, St. Louis. It is located 10 miles southwest of Fulton, 25 miles northeast of Jefferson City, 5 miles north of the Missouri River, and 80 miles west of St. Louis. The population within the 2.5-mile radius of the plant is low (approximately 30 residents). Approximately 4,500 people reside within a 10-mile radius of the plant. The plume exposure pathway has been expanded beyond the 10-mile radius to include the City of Fulton (population 10,000). Thus, the population within the plume exposure pathway is approximately 16,000. The plant site consists of 7,200 acres of land at the site, 6,800 of which are administered by the Missouri Department of Conservation as the Reform Conservation Area. Under this program, part of the area continues to be farmed, with income from farming providing funds for wildlife management and public recreation activities. Land within a 5-mile radius of the plant site is rural, consisting of 60 percent forest, 20 percent farm/crop land, and 20 percent pasture.

F. Cooper Nuclear Station

The Cooper Nuclear Station is a direct-cycle boiling water-type reactor with a net electrical generating capacity of 800,000 kilowatts. The facility is owned by the Nebraska Public Power District of Columbus, Nebraska. The plant is located on the Nebraska side of the Missouri River in Brownville, Nebraska, approximately 7 miles southwest of Rock Port, Missouri. The emergency planning zone within the Missouri side of the river is predominantly rural land, except for the towns of Rock Port, population 1,511, Phelps City, population 39, Langdon, population 32, and Watson, population 117. Atchison County is primarily affected by the emergency planning zone and is intersected by several major highways, including Interstate 29, U.S. Highway 136, U.S. Highway 275, and Missouri Highway 111. The total population at risk from a radiological incident in Atchison County is as follows: within 2 miles, approximately 15 people; within 5 miles, approximately 246 people; and within 10 miles, approximately 2,660 people.

IV. MEASURE OF PROBABILITY AND SEVERITY

The consequences of a radiological incident originating from one of the commercial nuclear power plants affecting the state can range in severity from insignificant to a high degree of radioactive contamination within the a 2- to 10-mile radius surrounding the facility. The most crucial concerns during a severe incident are safe evacuation and controlled access to the areas affected by a release of radioactive materials. In the aftermath, the main concerns are as follows: the extent of property needing to be decontaminated, contaminated food sources, and the time required to reach acceptable exposure rates and to allow the safe reentry of the public. Historically, due to their safe operation records, fixed nuclear

facilities have not represented a high risk to the state. The Reactor Safety Study conducted by the NRC rated the chances of a major nuclear disaster as very low (a probability of one in one million per plant operating year). The report concluded that the worst accident type that could affect a nuclear power plant would be one resulting in a meltdown, which could be expected to occur once in 20,000 years of reactor operation. The report also stated that a meltdown would likely cause less than one fatality or injury. This low hazard rating is due to all of the added safety engineered instrumentation used to monitor and shut down nuclear plant systems before any severe damage occurs.

V. IMPACT OF THE HAZARD

An incident at a nuclear power plant resulting in a General Emergency and evacuation (one where a release from the site boundary would be expected) could have a dramatic psychological impact on the uninformed population within the evacuation zone. The utilities and the State of Missouri have an active Radiological Emergency Preparedness program to prepare local jurisdictions and the general population surrounding the plant for responding to such an incident. This program includes in-depth training of resources both from the state and local jurisdictions, and regularly scheduled drills and exercises evaluated by the Federal Emergency Management Agency. Extensive planning has focused on implementation of the emergency response plan for both the state and local jurisdictions. Emphasis is placed on prompt notification of emergency organizations and the public; evacuation routes; reception and care centers for evacuees; monitoring for radiological contamination; emergency worker preparedness; and public information in the form of brochures distributed to residents within the emergency preparedness zone. These programs are essential to the protection of the general public.

VI. SYNOPSIS

Nuclear reactors have been designed to survive natural disasters such as tornadoes and earthquakes without damage to critical systems. Considerable emphasis is placed on multiple-level governmental reviews of the design, construction, and operation of each nuclear power plant. These safety reviews begin prior to construction and continue throughout the operating life of the plant. Radiological planning and preparedness programs monitored by state and federal agencies are in place to ensure that emphasis is placed on the safety of the general public within the emergency planning zone. In addition, the historical record for nuclear power plants gives no indication that a serious accident involving a nuclear power plant will occur.

VII. MAPS OR OTHER ATTACHMENTS

The following figures are attached to this annex:

- Emergency Planning Zone for Callaway Nuclear Power Plant, Figure J-1
- Emergency Planning Zone for Cooper Nuclear Station, Figure J-2
- Emergency Planning Zone for MURR, Figure J-3.

FIGURE J-1

EMERGENCY PLANNING ZONE FOR CALLAWAY NUCLEAR POWER PLANT

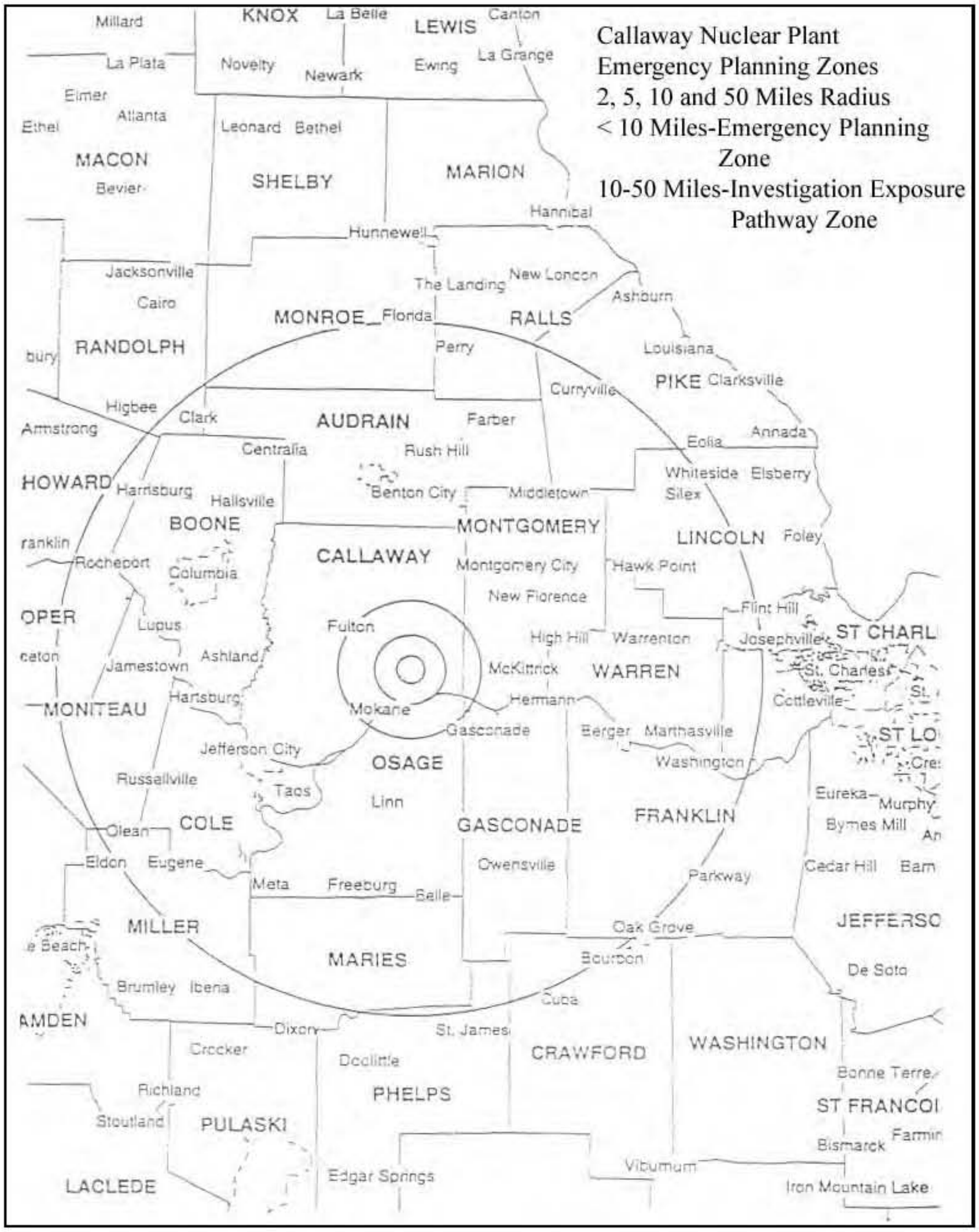


FIGURE J-2

EMERGENCY PLANNING ZONE FOR COOPER NUCLEAR STATION

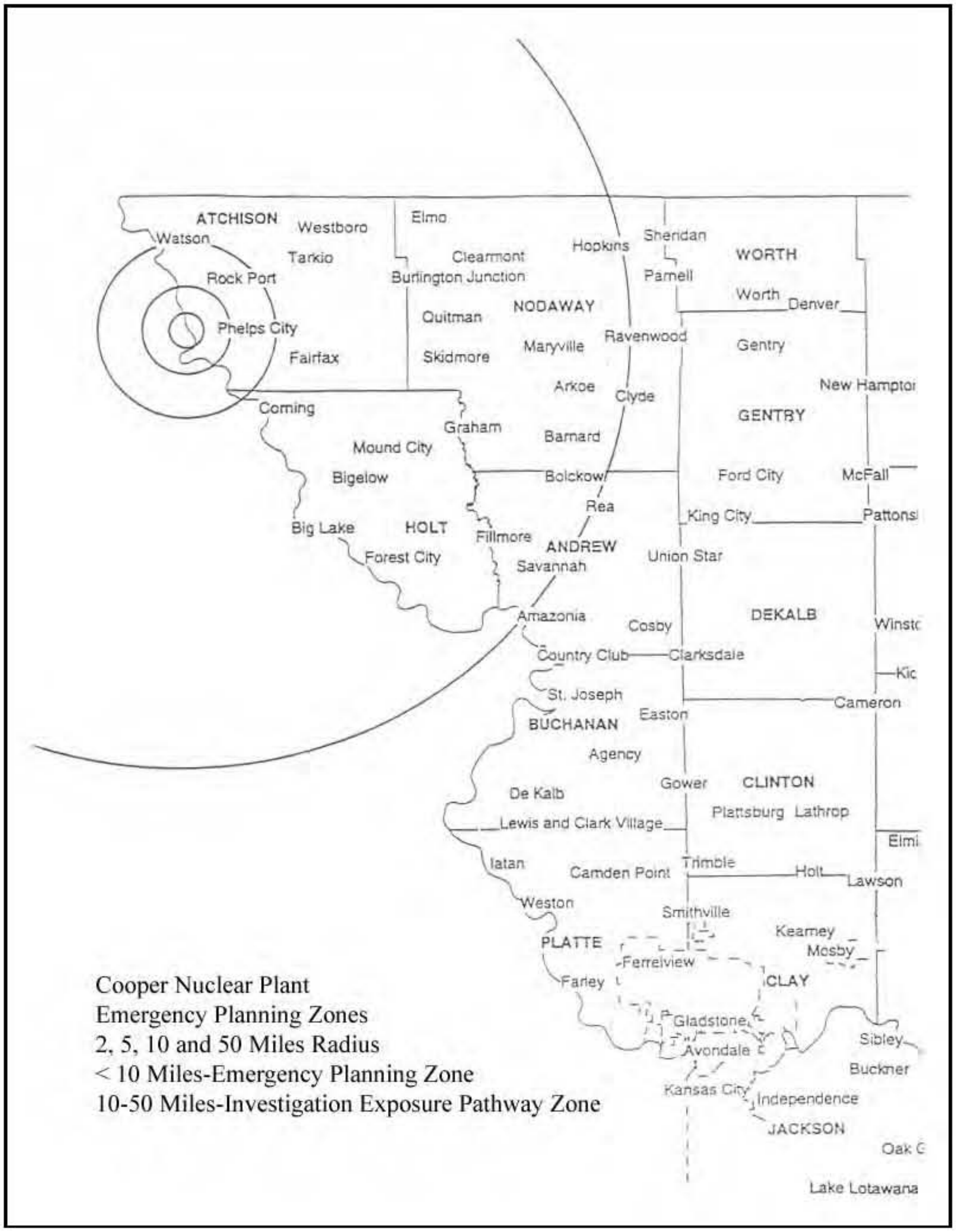
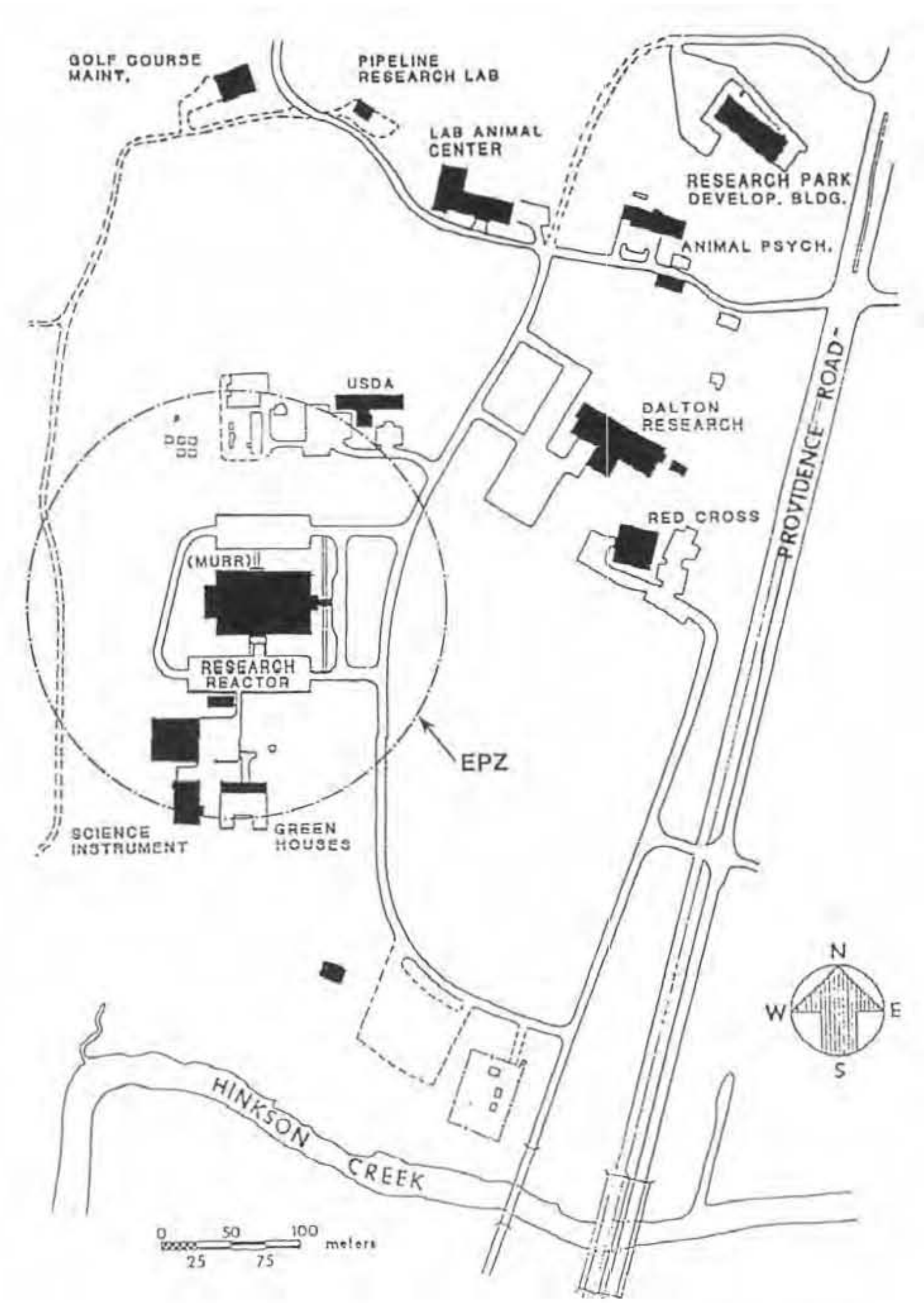


FIGURE J-3

EMERGENCY PLANNING ZONE FOR MURR



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ANNEX K

HAZARDOUS MATERIALS

I. TYPE OF HAZARD

Hazardous Materials

II. DESCRIPTION OF HAZARD

A hazardous material is any substance or material in a quantity or form that may pose a reasonable risk to health, the environment, or property. The category Hazardous Materials includes incidents involving substances such as toxic chemicals, fuels, nuclear wastes and/or products, and other radiological and biological or chemical agents. For the purposes of this hazard analysis section, only accidental or incidental releases of hazardous materials from two different kinds of incidents are addressed: fixed facility incidents and transportation-related accidents. In consideration of recent worldwide and national events, incidents involving terrorism or national attacks, which involve hazardous materials of any type, are addressed in the Terrorism, Attack, and Special Events Considerations annexes of this State Hazard Analysis (Annexes N, O, and Q, respectively).

Generally with a fixed facility, the hazards are pre-identified, and the facility is required by law to prepare a risk management plan done and provide a copy of this plan to the local emergency planning commission (LEPC) and local fire departments. Missouri Tier II forms must also be filed with the Missouri Emergency Response Commission (MERC) at the State Emergency Management Agency (SEMA). For specific site plans, each county LEPC is required by law to maintain a copy of these plans.

The exact location of a hazardous materials accident is not possible to predict. The close proximity of railroads, highways, waterways, and industrial facilities to populated areas, schools, and businesses could put a large number of individuals in danger at any time. In addition, essential service facilities, such as police and fire stations, hospitals, nursing homes, and schools near major transportation routes in the state are also at risk from a potential hazardous materials incident.

Federal Highway Administration statistics indicate that 1 of 10 motor vehicles is engaged in the transport of hazardous materials of some type. The U.S. Army Corps of Engineers also indicates that over 9,000 tons of petroleum products and over 200,000 tons of chemicals and related products are shipped annually by river barge via the Missouri River between Omaha and Kansas City.

Previous estimates have indicated that nationwide, over 4 billion tons of hazardous materials are shipped each year by various transportation modes. Approximately 20 flights each day out of Lambert Airport in St. Louis carry nuclear medicines, and Tri-State Motor Transit Company of Joplin has approximately 25 shipments of high explosives each week.

Missouri is also at risk because of the highway system and geographical location. With Interstate highways such as I-29, I-35, I-44, I-55 and I-70, Missouri offers premium routes for commercial carriers traversing the continental United States. Even arterial highways in Missouri, such as U.S. Highways 71, 13, 63, 54, and 61 are maintained to provide more favorable traveling conditions than in other central states. Also, the locations of nuclear facilities in relation to mines and fuel processing plants result in shipments of radioactive products and wastes across Missouri.

Missouri is at the crossroads for rail and truck transport of nuclear waste to the Yucca Mountain, Nevada, test site. Truck shipments alone will affect 25 different states, 266 counties, and two Indian Reservations. This will be a potentially large waste shipping campaign from as many as 19 nuclear reactors through other corridor states to Nevada.

The railroad systems in Missouri transport voluminous types and amounts of hazardous materials on their 6,351 miles of rails that transverse the state. Though individual cars may be placarded to reveal contents such as hazardous materials, only estimates can be obtained concerning volumes of such materials, because only the interstate traffic is counted or measured. Interstate shipments are accounted for where they originate and terminate.

Increased use and transport of materials across the country has created serious problems for emergency services personnel. Many factors can increase the magnitude of an otherwise simple transportation accident into an incident of potential hazard to high numbers of people. Following are potential factors to be considered:

Over 14,000 different chemicals are estimated as being shipped by the various transportation modes.

Some types of highly toxic chemicals do not require placarding if shipped in quantities of less than 1,000 pounds, even though lesser quantities could devastate a small town.

Only a few emergency response organizations in the larger cities and counties near the more metropolitan areas have had training for handling peacetime radiological problems. With recent federal grants and programs in place to provide funding for training, exercises, and equipment for state Homeland Security Response Teams (HSRT) and local responders the general capabilities of hazardous materials response personnel and teams statewide is expected to improve. Refer to Section N – Terrorism, of this State Hazard Analysis for more information on this topic.

There is a general lack of intelligence reports regarding activity of possible terrorists.

Other scenarios involve nuclear terrorism and faulty re-entry of nuclear-equipped satellites to earth (such as COSMOS 954 in 1978 and SKYLAB in 1980). However, transport of radioactive materials presents the most probable scenario for a radiological incident. The Department of Energy is currently shipping by truck radioactive waste to a repository in the states of Texas and Utah. These trucks cross Missouri through St. Louis and Springfield on Interstate corridors I-270 and I-44.

The federal government has finalized development of long-term repositories for spent fuel and other high-level radioactive wastes, and for transuranics (known as TRU waste), at Yucca Mountain, Nevada, and Carlsbad, New Mexico, respectively. Speculations have suggested that up to 3,600 shipments per year may go to these facilities, depending on several variables.

A large number of hazardous material shipments come from two corporations in Missouri. Tyco/ Mallinckrodt Medical in Maryland Heights (St. Louis County) and Tri-State Motor Transit in Joplin (Jasper County). Tyco/Mallinckrodt Medical is one of the largest manufacturers of radiopharmaceuticals in the world. Tri-State is one of the largest single private carriers of radioactive materials in the world, in addition to transporting all classes of explosive materials and other toxic and hazardous materials.

Missouri is a transportation hub. The Interstate corridors of I-44, I-70 and I-55 are the most commonly used for truck transport. U.S. Highway 36 crosses the northern counties, while U.S. 60 crosses the southern counties. U.S. Highways 71, 13, 65, and 63 are also well-traveled north-south arterial routes.

Although there are railroads throughout Missouri, the UP route between St. Louis and Kansas City is the most used for large radioactive material shipments. The switching yards at St. Louis and Kansas City when combined process more of these transcontinental trains than any other yards in the country.

During any radiological emergency, regardless of the cause, local officials and emergency responders will likely require state or federal support in the detection, monitoring, and analysis of radiological data for decision-making.

In 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) of the Centers for Disease Control and Prevention (CDC) began funding selected state health departments to participate in the Hazardous Substances Emergency Events Surveillance (HSEES) system. Missouri was added to this effort in fiscal year 1994 and became the twelfth participating state. The Missouri Department of Health and Senior Services (MDHSS) administers Missouri's HSEES participation. The goal of this surveillance project is to provide data in an effort to reduce injuries and deaths to first responders, employees, and the general public from hazardous substance emergencies.

Beginning in 2002, a newly updated data-collection form, approved by the Office of Management and Budget, went into effect. For each event, information was collected about the event, substance(s) released, victims, injuries, and evacuations.

HSEES defines hazardous substances emergency events as uncontrolled or illegal releases or threatened releases of hazardous substances. Events involving releases of only petroleum are not included. Events are included if (1) the amount of substance released (or that might have been released) needed (or would have needed) to be removed, cleaned up, or neutralized according to federal, state, or local law; or (2) the release of a substance was threatened, but the threat led to an action (for example, evacuation) that could have affected the health of employees, emergency responders, or members of the general public.

Various data sources were used to obtain information about these events. These sources included, but were not limited to, Missouri Department of Natural Resources (DNR), United States Coast Guard, National Response Center (NRC), MDHSS Bioterrorism Surveillance, United States Department of Transportation (DOT) Hazardous Materials Information System (HMIS), Missouri State Highway Patrol (MSHP), private companies and Missouri Press Clipping Bureau (media). Census data were used to estimate the number of residents in the vicinity of the events. All data were computerized using a web-based data entry system provided by ATSDR.

III. HISTORICAL STATISTICS

The MDNR/ALPD Environmental Emergency Response (EER) Section receives most of the environmental emergency response reports in Missouri. All environmental emergencies are to be reported, 24 hours a day, to (573) 634-2436. Approximately 3,500 reports were received by MDNR/EER in fiscal year 2005.

During 2002 and 2003, a total of 824 events were reported to MDHSS. Six (0.73%) of these events were threatened releases, three (0.36%) were both actual and threatened releases. A total of 426 (52%) occurred in fixed facilities. The statistics reported herein are based primarily on the data from these 2002 to 2003 HSEES events and the associated data analysis report published by MDHSS (this report is available on-line at www.dhss.state.mo.us/hsees).

For each fixed-facility event, one or two types of area involved in the release can be selected. Of all 426 fixed-facility events, 409 (96%) had one type of area; 10 (2%), a combination of two area types, and 7

(2%), no type of area reported. Among events with one type of area reported, the main area was classified as follows: 107 (26%) indoor, non-industrial, living (residence), 82 (20%) storage areas above ground (i.e., tank, storage shed, and warehouse), 70 (17%) indoor, non-industrial, non-living and 32 (8%) ancillary processing equipment (Figure K-1). Of the 10 events with two areas, 4 (40%) involved ancillary processing equipments in combination with other types of area. Of the 398 transportation-related events, 361 (91 %) occurred during ground transport (e.g., truck, van, or tractor), and 35 (9%) involved transport by rail (Figure K-2).

Factors contributing to the events consisted of primary and secondary entries and were reported for 804 (98%) events. Of reported factors, 174 (22%) of fixed-facility events and 250 (31 %) of transportation-related events involved human error as the primary factor; 105 (13%) of fixed facility and 72 (9%) of transportation-related events involved equipment failure as the primary factor (Figure K-3).

Of the 818 events involving actual releases, 701 (86%) involved the release of only one substance. Two substances were released in 46 (6%) events, and 71(9%) involved the release of more than two substances. Fixed-facility events were more likely than transportation events to have two or more substances involved in an event (76% vs. 24%). The substances most frequently released were Ammonia, Hydrochloric Acid, Ethyl Ether, and Acetone. These substances were grouped into 16 categories. The categories most commonly involved in fixed-facility events were ammonia (113, 19%), acids (102, 17%), and volatile organic compounds (97, 16%). In transportation-related events, the most common releases were volatile organic compounds (77, 17%), acids (63, 14%), and other inorganic substances (56, 12%).

The number of events by month ranged from 55 (7%) in December to 90 (11 %) in June, with the largest proportions occurring from June-August/Summer. The proportion of events ranged from 123 (15%) to 143 (17%) during weekdays, and from 72 (9%) to 78 (9%) during weekend days. Of all 711 (86%) events for which time of day or time category was reported, 228 (32%) occurred from 6:00 a.m. to 11:59 a.m., 215 (30%) from 12:00 p.m. to 5:59 p.m., 139 (20%) from 6:00 p.m. to 11:59 p.m., and the remainder during the early hours of the day.

A total of 524 victims were involved in 262 events (32% of all events). Of the events with victims, 170 (65%) events involved only one victim, and 55 (21 %) involved two victims. Of all victims, 347 (66%) were injured in fixed-facility events. Fixed-facility events were more likely to have more than one victim per event (67, 26%) than were transportation events (25, 10%).

Responders (204, 39%) constituted the largest proportion of the population groups injured, followed by employees (147, 28%) of which two are members of a company response team, members of the general public (135, 26%) and students (35, 7%) (Figure K-4). 150 emergency response personnel were injured in fixed-facility events. Of those, 137 (92 %) were police officers, 10 (7%) were career firefighters, and 1 (1 %) was a firefighter that was unspecified. Fifty-six emergency-responder victims were injured in transportation-related events. Of these, most (48, 86%) were police officers. Police officers were more frequently victims in fixed facility-related events than in transportation-events.

Of all reported injuries and symptoms, those most common in fixed-facility events were respiratory (174, 35%), headache (110, 22%), eye irritation (54, 11 %), other (36, 7%), chemical burns (33, 7%) and gastrointestinal system (26, 5%). In transportation-related events, respiratory (98, 50%), headache (40, 20%), trauma (31, 16%) and chemical burns (10, 5%) were reported most frequently. In a large proportion of the instances, trauma might have resulted from a chain of events, such as a motor vehicle accident, leading to the release of a hazardous substance, and not necessarily by the exposure to the substance itself.

The largest proportion of victims (severity/disposition) 250 (48%) were treated and released from a hospital; 182 (35%) had adverse health effects experienced within 24 hours of the event reported by an official, and 8 (2%) died (Figure K-5).

During calendar year 1999-2003, local, state and federal officials reported 9,160 seizures of methamphetamine labs, dumpsites and locations of inactive labs in Missouri – more than any other state in the nation.

Missouri reported a total of 309 HSEES events related to methamphetamine for calendar years 1999-2003. The largest proportion of events occurred in fixed facilities. Each methamphetamine event was categorized into the type of situation such as theft, fixed-lab (private residence, abandoned lab) and mobile lab. There were 203 (66%) fixed labs, 53 (17%) mobile labs and 53 (17%) events in which chemicals were stolen from an agricultural facility (Figure K-6).

In the 254 methamphetamine events involving injuries, respiratory symptoms consistently have been most frequently reported. The number of deaths associated with events continues to suggest the need to evaluate not only the danger posed by methamphetamine substances, but also the circumstances surrounding the events (e.g., insufficient personal protection against adverse health effects). Police officers continue to be the most commonly reported victims of methamphetamine emergency events (Figure K-7).

In summary of all HSEES events between 1994 and 2003, the largest proportion of events occurred in fixed facilities. However, the number of reported transportation-related events is increasing. The increase is partially due to the utilization of the U.S. Department of Transportation’s Hazardous Materials Information System as a primary notification source for transportation events. In addition, the total number of events continued to increase over time (Figure K-8). The increase in the number of events may have been due, at least in part, to the expansion of reporting sources.

IV. MEASURE OF PROBABILITY AND SEVERITY

A. Hazardous Materials Transportation Accident

The probability of occurrence is rated as high because of the large volume of hazardous materials being hauled over the highways and railways. This rating means that the probability of occurrence is considered sufficiently high as to assume that an event will occur at least once within any mode of transportation (including water, pipeline, and air) during a 3- year HSEES reporting period.

The severity of the consequences is rated as moderate, but may be either low or high depending on the location of the accident and the time of day. This rating means injuries and/or death are expected only for exposed personnel over extended periods of time or when individual personal health conditions create complications.

B. Hazardous Materials Fixed Facility Accident

The probability of occurrence is rated as moderate. With the new regulations from EPA and OSHA, along with more stringent state laws and employee awareness training, this rating may be

lowered to low or raised to high based on past performance. This rating means the probability of occurrence is possible during the expected lifetime of the facility.

The severity of consequences is rated as moderate but may be either low or high depending on the type and amount of chemical released. This means the chemical is expected to move into the surrounding environment at a concentration sufficient to cause serious injuries and/or death, unless prompt and effective corrective actions are taken. Injuries and/or death would be expected only for personnel exposed over an extended period or when individual personal health conditions create complications.

Note: The severity to the environment will vary in every case depending on the amount, type, and method released to determine the damage to property and the environment. Close coordination between the Missouri Department of Natural Resources, EPA, the local jurisdiction, and the spiller (responsible party) is required to ensure that potential impacts to public health and the environment are adequately addressed.

V. IMPACT OF THE HAZARD

The entire State of Missouri is susceptible to this type of hazard, depending on a number of factors such as the following:

- Type of chemical
- Amount released/spilled
- Method of release
- Location of release
- Time of day
- Weather conditions.

This hazard could have a significant impact on the public health, the environment, or private property.

The impact of this type of disaster will likely be localized to the immediate area surrounding the incident. The initial concern will be for the people, then the environment. If contamination occurs, then the spiller is responsible for the cleanup actions and will work closely with the Missouri Department of Natural Resources, EPA, and the local jurisdiction to ensure that cleanup is done safely and in accordance with federal and state laws.

Local government (county or municipal) is more often directly impacted by radiological incidents than state or federal government. Local responders are generally the first on scene for any incident. Therefore, they have the responsibility for treating any injured victims and transporting them to a hospital for more complete medical care. Also, local first responders have the initial responsibility for controlling exposure of emergency workers and the public to any radioactive materials and to contain the spread of radioactive contamination as much as possible. While cleanup of any actual spill of radioactive materials rests with the shipper (in most cases), local responders may be required to provide site control for several hours until the responsible parties arrive on the scene.

A past survey was completed of Missouri fire departments across the state, asking their perception of their own capabilities to respond to a radiological incident. Of the 433 departments surveyed, only 118 responded. Of those, 21 believed they could adequately handle a radiological incident until proper authorities arrive.

This indicates that pockets of adequate radiological response capabilities are available throughout the state. However, the main transportation corridors have some gaps. It is also clear that more training needs to be encouraged along these corridors. The same consideration must be given to any county located under commercial flyways or where it might be possible for a fallen satellite to leave a contaminated "footprint" (COSMOS 954 left a 200-mile footprint in the Northwest Territory of Canada in 1978).

VI. SYNOPSIS

Any disaster or emergency incident could result in additional concerns when it involves of hazardous materials. For example, during the floods of 1993, a large propane tank farm in St. Louis was threatened by rising floodwaters, forcing evacuations of nearby residents in several areas. Another hazardous materials incident related to the 1993 floods involved an on-going ammonia release from the La Roche Industries, Inc., facility near Crystal City, Missouri, caused by power failure and failure of the cooling system on a large ammonia tank, ultimately resulting in off-gassing of ammonia through the tank's pressure relief check valves. The ammonia cloud over the plant led to a declaration of restricted air space in the plant vicinity for several days.

In addition, thousands of chemical containers ranging from household products and 55-gallon drums to 10,000-gallon fuel storage tanks were displaced statewide as a result of the flood damage. A Federal Disaster Declaration was issued, the Federal Response Plan (FRP) was implemented, and the Emergency Support Function (ESF) #10 – Hazardous Materials Annex was activated to support the statewide response to hazardous materials incidents like these and others that resulted from the flooding.

Each emergency event will need to be evaluated on an incident-specific basis, and top priority must be given to the protection of the public, then the environment, and finally property.

VII. MAPS OR OTHER ATTACHMENTS

Tier II Forms are filed and maintained by the Missouri Emergency Response Commission (MERC) at SEMA. Site-specific plans are on file with each county's Local Emergency Planning Commission (LEPC). Transportation and evacuation routes are addressed in each county emergency operations plan.

See Figure H-2 for The Natural Gas Pipeline Map.

The SEMA Homeland Security Response Teams Map, included in Annex N – Terrorism, of this State Hazard Analysis, indicates 28 existing or proposed Homeland Security Response Teams for the State of Missouri. A few of these teams include hazardous materials response teams with enhanced capabilities for response to WMD incidents, including incidents involving nuclear or radiological materials, biological agents, and chemical agents. The SEMA Terrorism Program should be contacted to determine the capabilities of these Homeland Security Response Teams in specific areas.

Attachments to this section include the following: the MO HSEES 2002 to 2003 Data Analysis Report Charts (see Figures K-1 through K-8) and the Missouri Rail Freight Carriers System Map (see Figure K-9).

FIGURE K-1

Fixed-facility events by area type, Missouri Hazardous Substances Emergency Events Surveillance, 2002-2003.

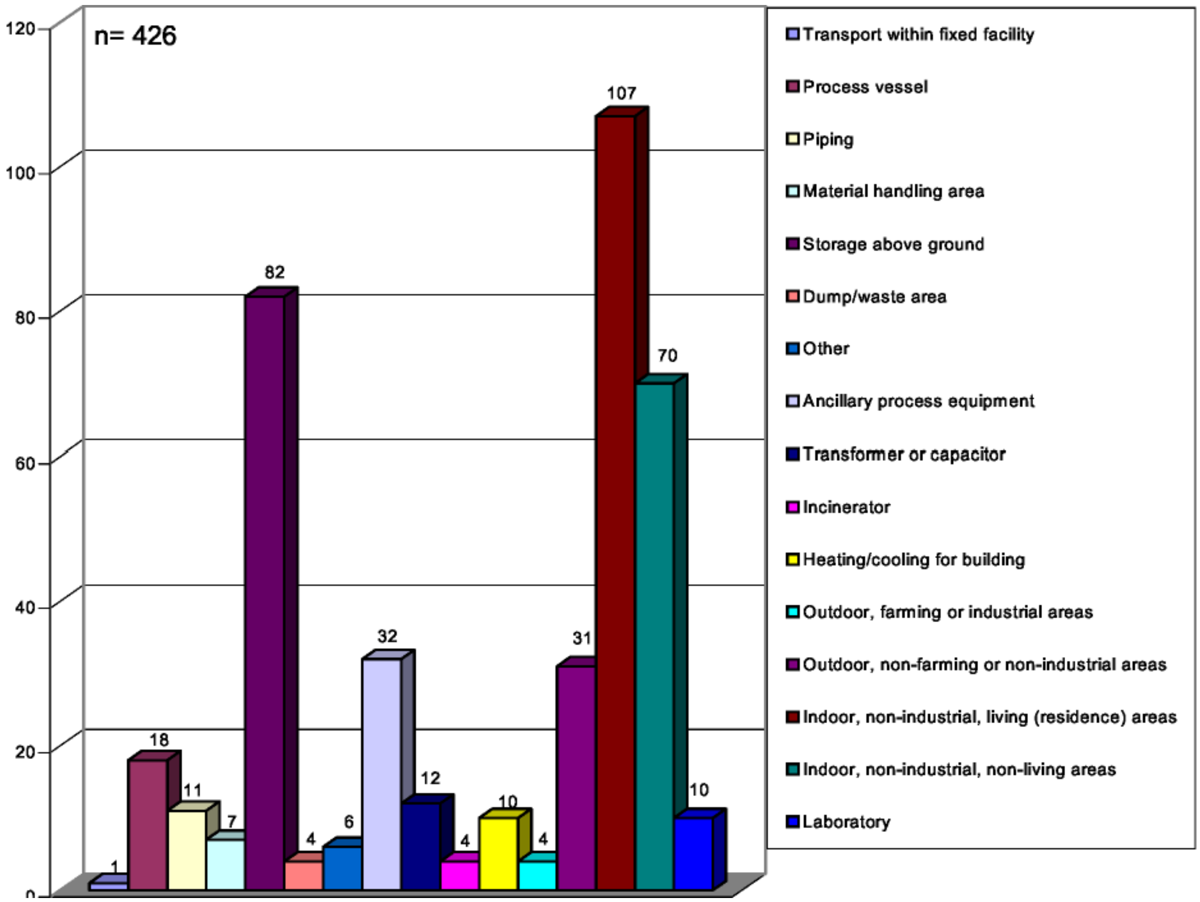


FIGURE K-2

Transportation-related events by mode of transportation, Missouri Hazardous Substances Emergency Events Surveillance, 2002-2003

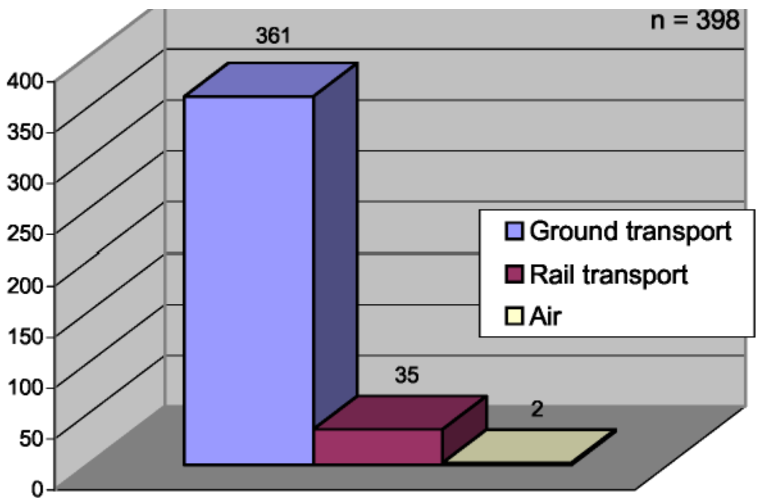


FIGURE K-3

Primary cause of release by event type, Missouri Hazardous Substances Emergency Events Surveillance, 2002-2003

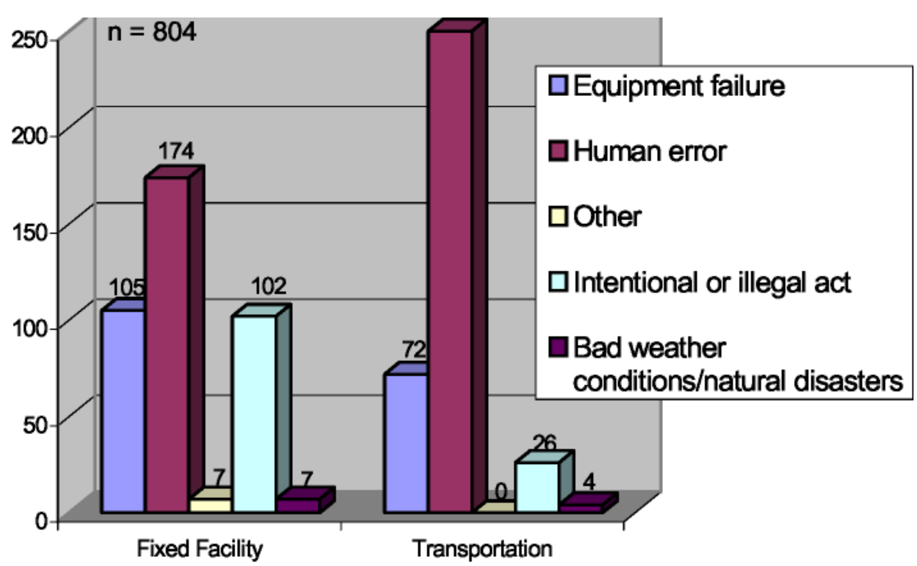


FIGURE K-4

Number of victims by victim category, Missouri Hazardous Substances Emergency Events Surveillance, 2002-2003

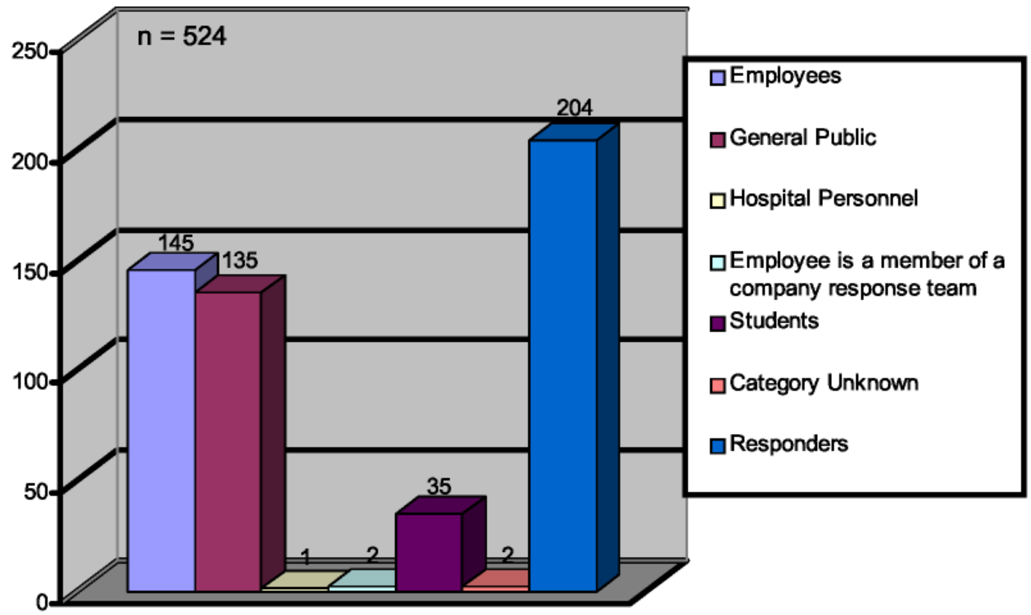


FIGURE K-5

Victims by severity of adverse health effects, Missouri Hazardous Substances Emergency Events Surveillance, 2002-2003

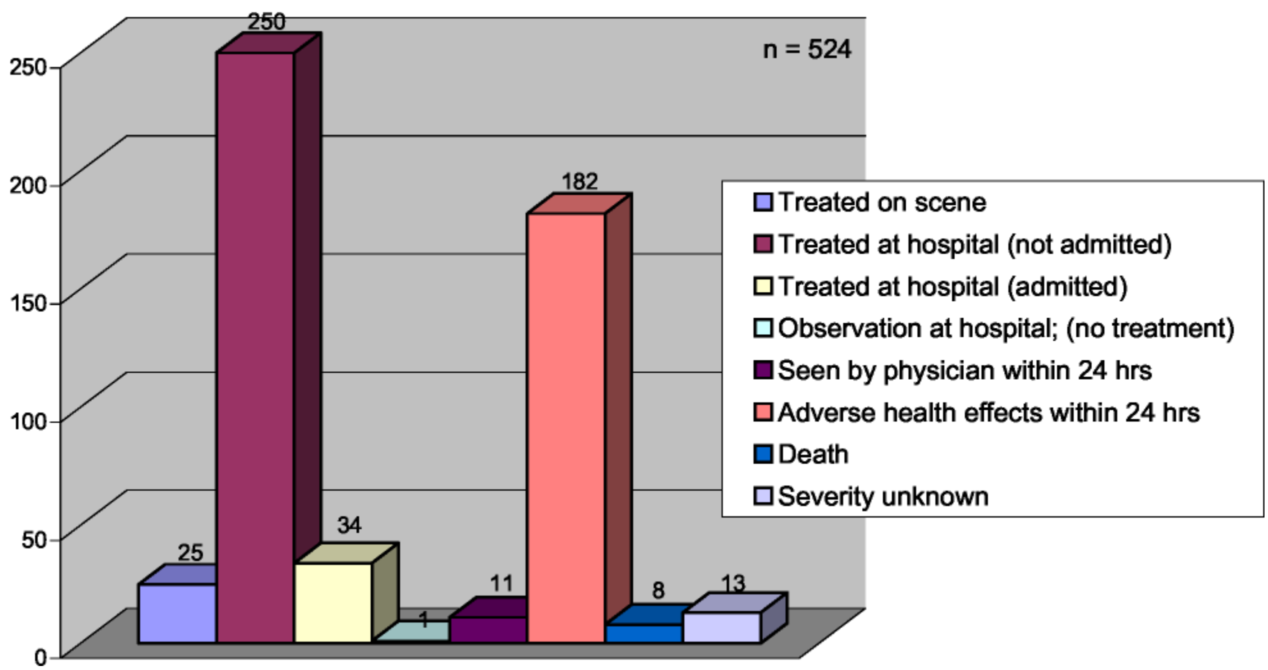
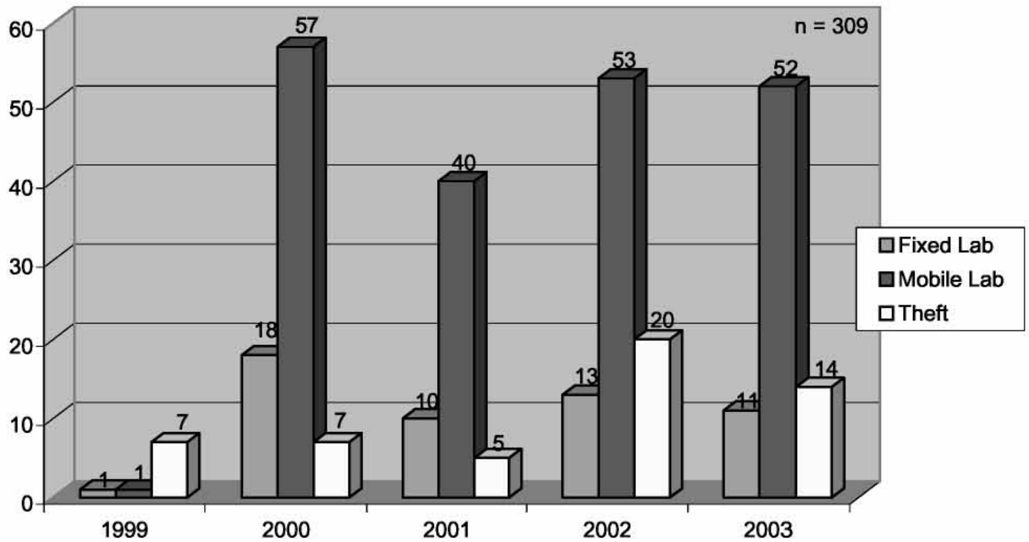


FIGURE K-6

Hazardous Substances Emergency Events Surveillance System
2002—2003 Missouri Summary

Figure 7. - Methamphetamine related-events situation, by year, Missouri Hazardous Substances Emergency Events Surveillance, 1999-2003.



A total of 654 substances were involved in all methamphetamine events, of which 2 (.3%) were reported as threatened releases. The substances most frequently released were ammonia, ethyl ether, hydrochloric acid, and methamphetamine chemicals not otherwise specified (NOS) (Table 8).

Table 8. - The 10 most frequent substances involved in methamphetamine events, Missouri Hazardous Substances Emergency Events Surveillance, 1999-2003

Number	Standardized Substance Name	Frequency
1.	Ammonia	163
2.	Ethyl Ether	103
3.	Hydrochloric Acid	76
4.	Methamphetamine Chemicals NOS*	56
5.	Acetone	43
6.	Phosphorus	42
7.	Acid NOS*	36
8.	Iodine	30
9.	Solvent NOS*	21
10.	Sulfuric Acid	15
	Total	**585**

FIGURE K-7

Number of methamphetamine-related victims by victim category, Missouri Hazardous Substances Emergency Events Surveillance, 1999-2003

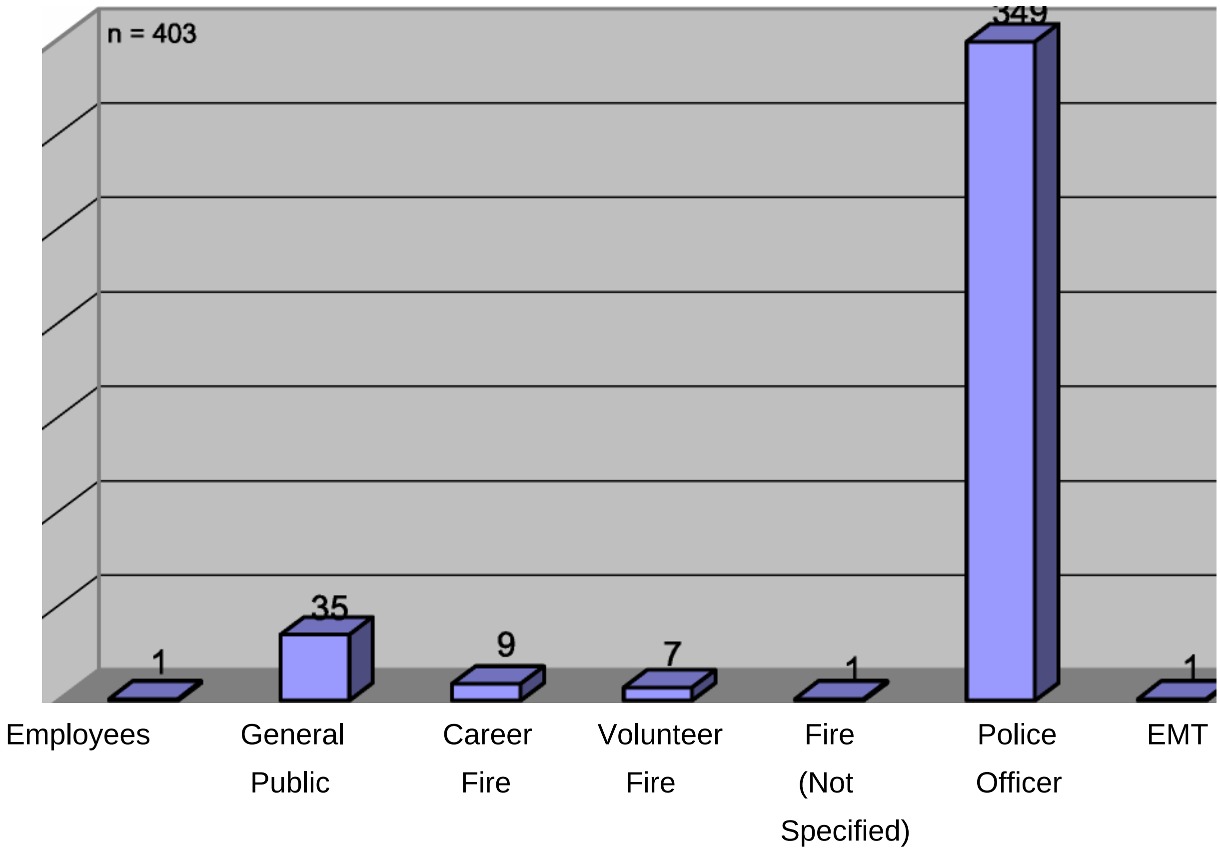


FIGURE K-8

Cumulative data by year, Missouri Hazardous Substances Emergency Events Surveillance, 1994-2003

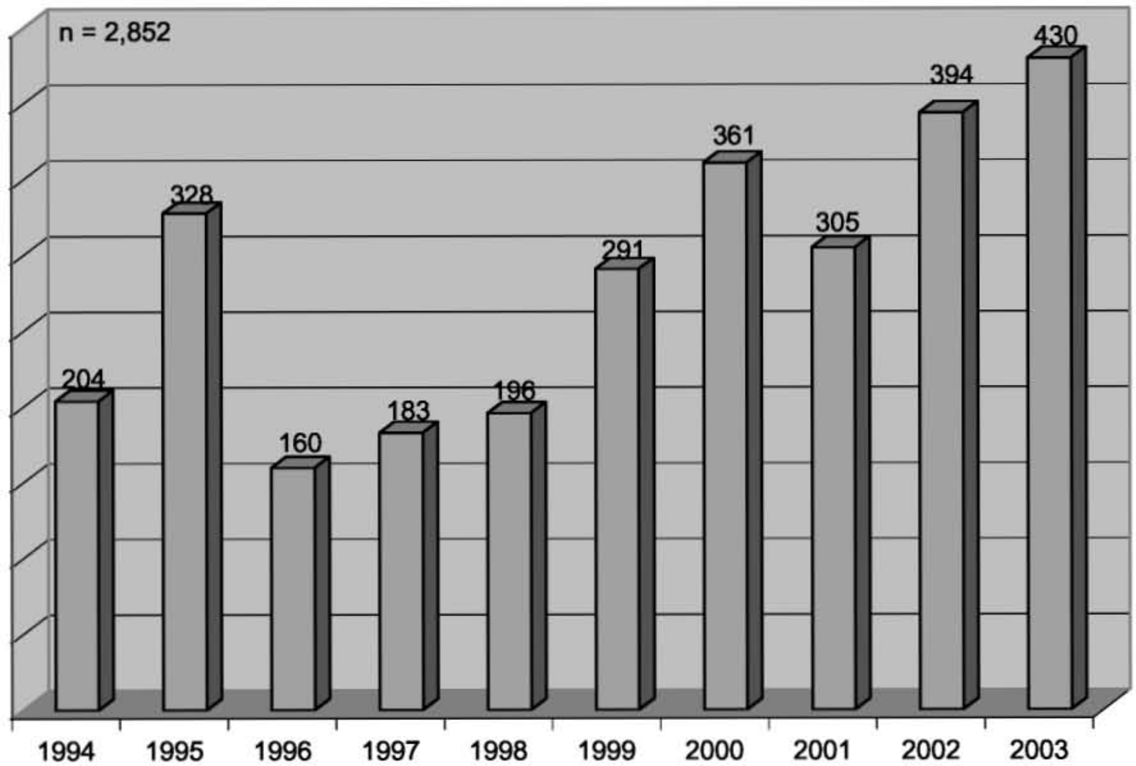
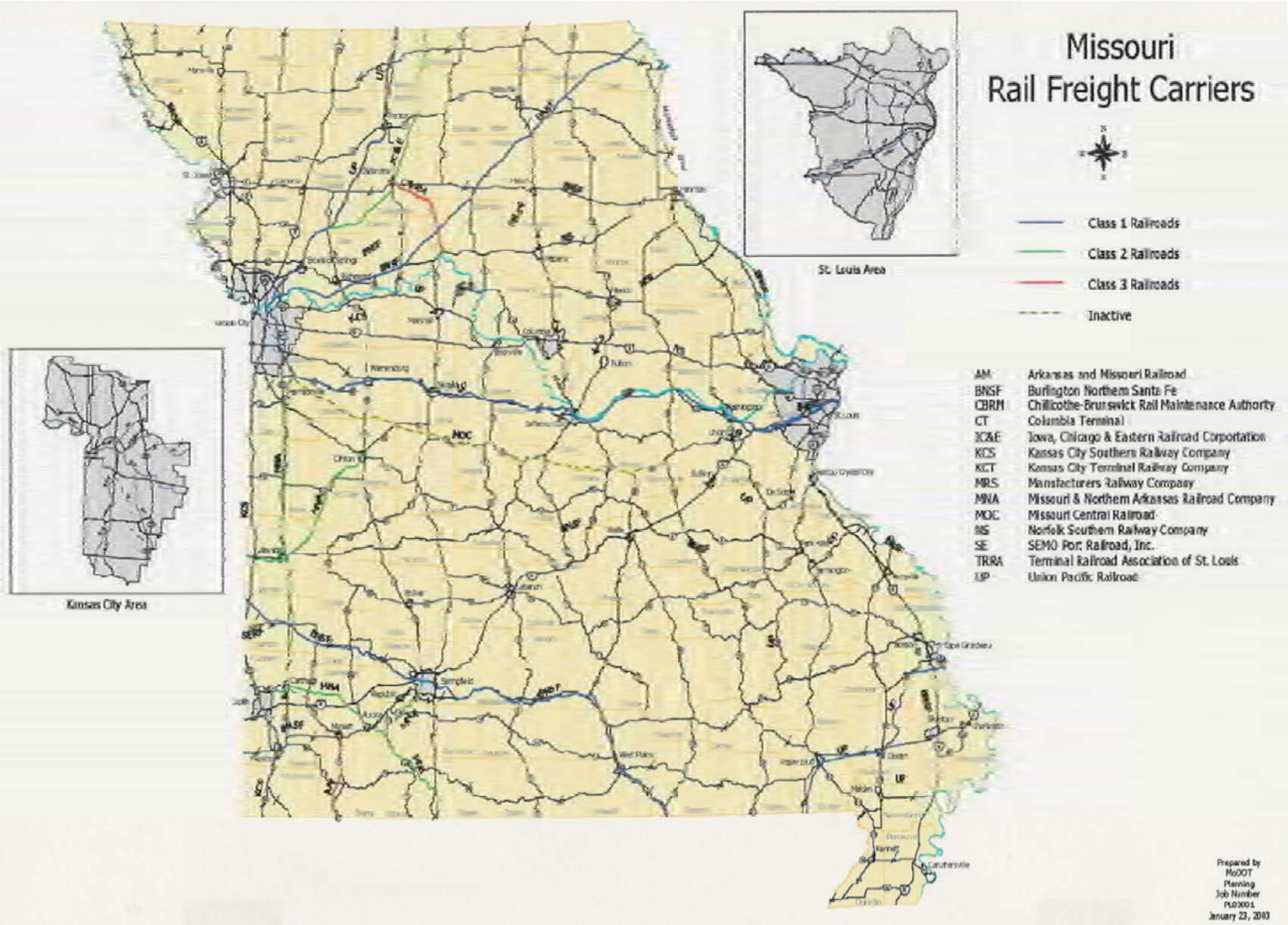


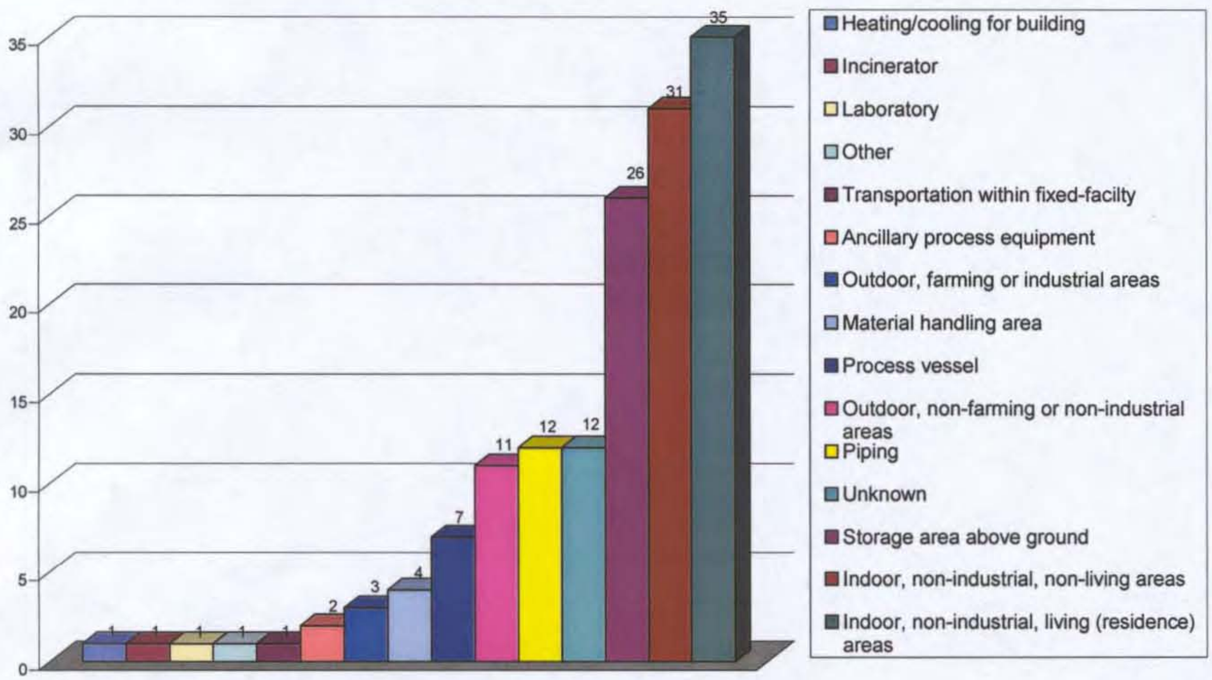
FIGURE K-9


Missouri
Rail Freight Carriers
Class 1 Railroads
Class 2 Railroads
Class 3 Railroads
Inactive
St. Louis Area
Kansas City Area
AM Arkansas and Missouri Railroad
BNSF Burlington Northern Santa Fe
CBRM Chillicothe-Brunswick Rail Maintenance Authority
CT Columbia Terminal
IC&E Iowa, Chicago & Eastern Railroad Corportation
KCS Kansas City Southern Railway Company
KCT Kansas City Terminal Railway Company
MRS Manufacturers Railway Company
MNA Missouri & Northern Arkansas Railroad Company
MOC Missouri Central Railroad
NS Norfolk Southern Railway Company
SE SEMO Port Railroad, Inc.
TRRA Terminal Railroad Association of St. Louis
UP Union Pacific Railroad
Prepared by
MoDOT
Planning
Job Number
January 23, 2003

Hazardous Substances Emergency Events Surveillance System
2004 Missouri Summary

A total of 148 (49%) events occurred in fixed facilities. For each fixed-facility event, one or two types of area or equipment involved in the fixed facility where the event occurred could be selected. Of all 148 fixed-facility events, 134 (91%) reported one type of area and 2 (1%) reported a combination of two area types. Type of area was not reported for 12 (8%) events. Among events with one type of area reported, the main areas were classified as follows: 35 (26%) indoor, non-industrial, living (residence) areas, 31 (23%) indoor, non-industrial, non-living areas, and 26 (19%) storage area above ground (i.e. warehouse, tank, storage shed) (Figure 1).

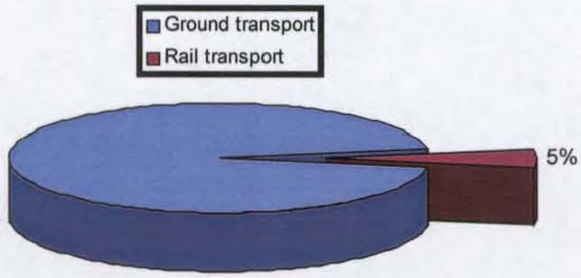
Figure 1. - Areas of fixed facilities involved in events
Missouri Hazardous Substances Emergency Events Surveillance, 2004



Of the 152 transportation-related events, 144 (95%) occurred during ground transport (e.g., truck, van, automobile or tractor) and 8 (5%) involved transport by rail (Figure 2). No events involved water, air, and pipeline transportation modes. Most (86%) ground transportation events involved trucks. The largest proportions of transportation-related events occurred during unloading of a stationary vehicle or vessel (65 [43%]) and from a moving vehicle or vessel (38 [25%]). Of the 152 transportation-related events, 33 (22%) involved a release en route that was later discovered at a fixed facility.

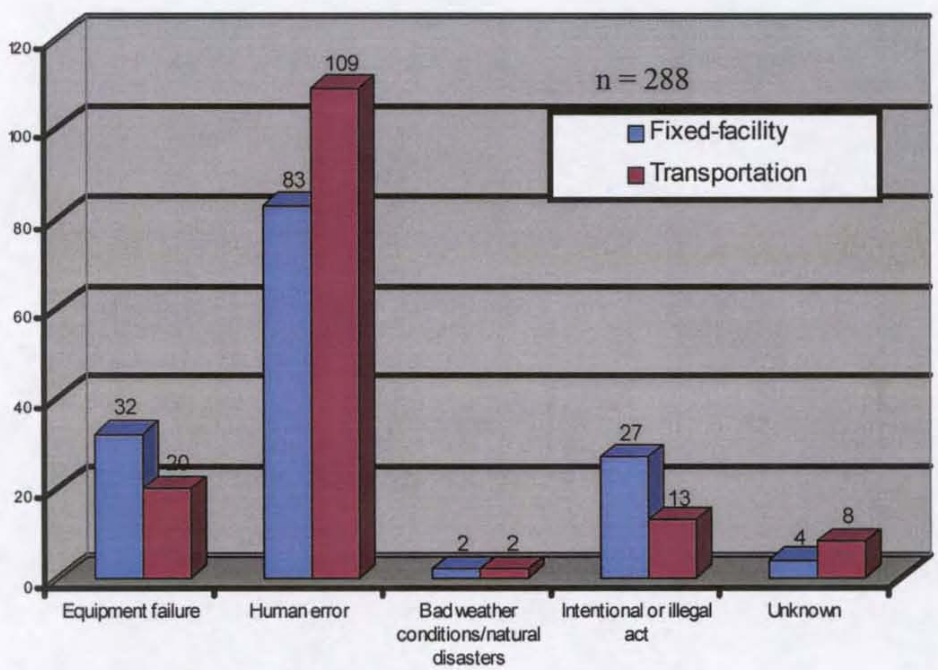
Hazardous Substances Emergency Events Surveillance System
2004 Missouri Summary

Figure 2. - Distribution of transportation-related events, by type of transport
Missouri Hazardous Substances Emergency Events Surveillance, 2004



Factors contributing to the events consisted of primary and secondary entries. Primary factors were reported for 288 (96%) events (Figure 3a). Of the reported primary factors, most (29%) fixed-facility and most (38%) transportation-related events involved human error.

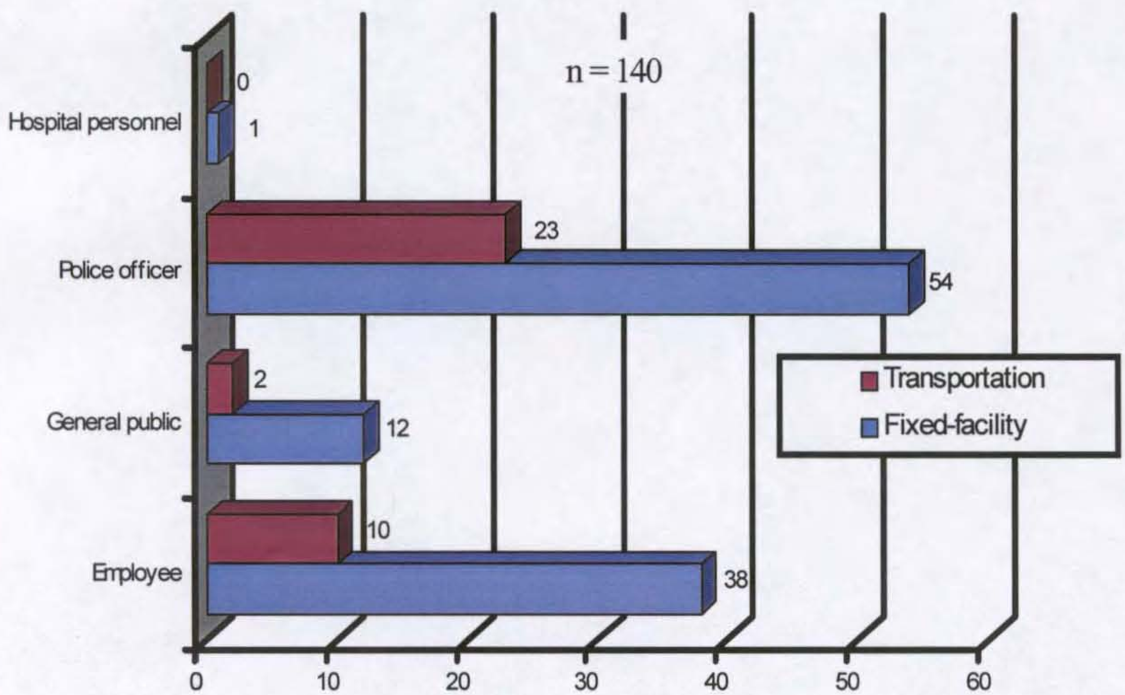
Figure 3a. - Primary factors reported as contributing to events by event type
Missouri Hazardous Substances Emergency Events Surveillance, 2004



Hazardous Substances Emergency Events Surveillance System
2004 Missouri Summary

Police officers (77 [55%]) constituted the largest proportion of the population groups injured, followed by employees (48 [34%]) (Figure 4). In fixed-facility events, 54 emergency response personnel were injured. All of those were police officers. Police officers were injured more frequently in fixed facility-events (70%) than in transportation-related events (30%) (Figure 5).

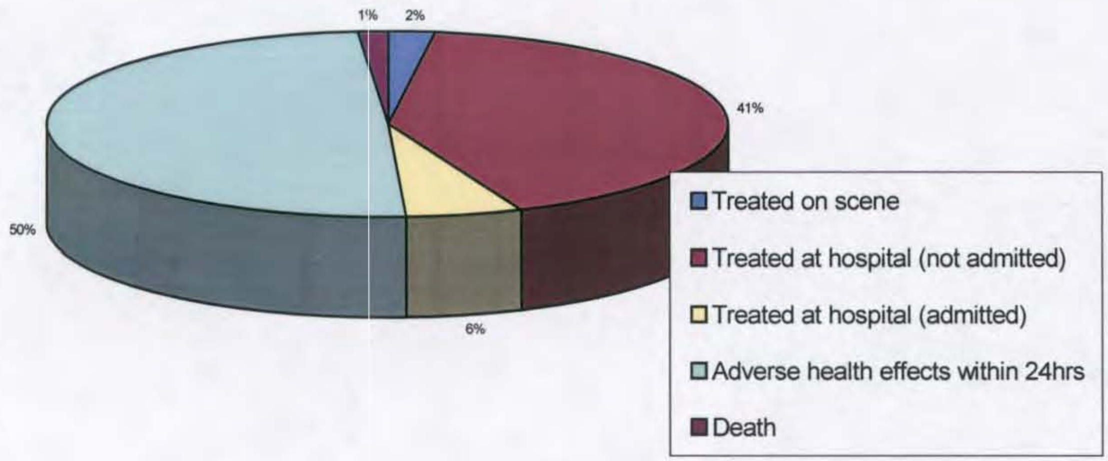
Figure 4. - Number of victims, by population group and type of event
Missouri Hazardous Substances Emergency Events Surveillance, 2004



Hazardous Substances Emergency Events Surveillance System
2004 Missouri Summary

Only one event involved more than 10 injured people. Eleven employees were taken to the emergency room after coming in contact with chemical fumes. An aerosol can of brake parts cleaner and a duct liner adhesive, used to clean machinery, reacted together to cause a fume. The two different industrial chemicals were being used simultaneously and they produced a respiratory irritant. The employees were taken to a medical facility where they were decontaminated and treated for respiratory problems, nausea and dizziness. One employee fainted. Police, fire, emergency management personnel, and emergency medical personnel were called to the scene and the area was ventilated.

Figure 6. - Injury disposition - Missouri Hazardous Substances Emergency Events Surveillance, 2004



Nearby populations

The proximity of the event location in relation to selected populations was determined using geographic information systems (GIS) or health department records. Residences were within ¼ mile of 217 (72%) events, schools within ¼ mile of 35 (12%) events, hospitals within ¼ mile of 6 (2%) events, nursing homes within ¼ mile of 17 (6%) events, licensed daycares within ¼ mile of 42 (14%) events, industries or other businesses within ¼ mile of 158 (53%) events and recreational areas within ¼ mile of 29 (10%) events. Information for proximity of the event location in relation to selected populations was missing for 52 events.

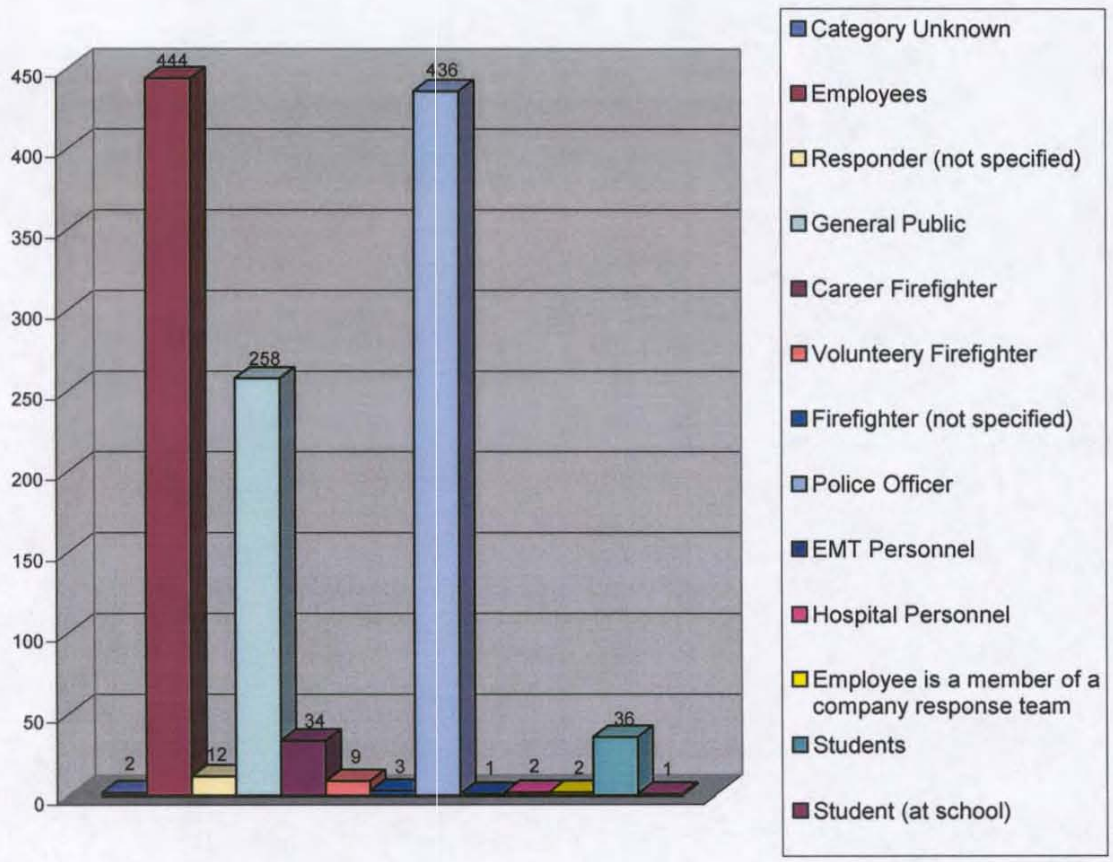
The number of events at which persons were at risk of exposure was determined primarily using GIS. There were 205 (68%) events with persons living within ¼ mile of the event; 242 (81%) events with persons living within ½ mile; and 248 (83%) events with persons living within 1 mile. Information on the number of people living within ¼, ½, and 1 mile of the event was missing for 51 events.

Hazardous Substances Emergency Events Surveillance System
2004 Missouri Summary

Respiratory irritation has consistently been the most frequently reported injury. Employees continue to be the most commonly reported victims of acute chemical releases. However, responders constitute a large proportion of the victims as well (Figure 7). The number of injured responders has decreased from 115 in 2002 to 77 in 2004. This decrease likely results from less police officers injured when responding to events involving the manufacture of methamphetamine. This may be a result of increased awareness and training for methamphetamine lab seizures among state and local law enforcement.

The number of deaths associated with acute hazardous substances events has decreased in recent years. Many of these deaths were attributed to nonchemical circumstances causing the events (e.g., a M.V.A. resulting from high-speed travel of a truck pulling an ammonia tank).

Figure 7. - Number of victims, by category and year
Missouri Hazardous Substances Emergency Events Surveillance, 1993–2004



Hazardous Substances Emergency Events Surveillance System
2004 Missouri Summary

Appendix A. - The 10 most frequent substances involved in events, Missouri Hazardous Substances Emergency Events Surveillance, 2004

Number	Standardized Substance Name	Frequency
1.	Ammonia	43
2.	Hydrochloric Acid	26
3.	Mercury	23
4.	Acetone	20
5.	Phosphorus	19
6.	Sulfuric Acid	19
7.	Sodium Hydroxide	15
8.	Methamphetamine Chemicals NOS*	13
9.	Ethyl Ether	11
10.	Proteat	10
	Total	**199**

*Not Otherwise Specified

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MDHSS. 2002. "Hazardous Substances Emergency Events Surveillance (HSEES) Program, Methamphetamine Events Analysis Report, 1999-2001, available electronically through the MDHSS homepage at www.dhss.state.mo.us/hsees.

Other past and present statistics were obtained from the following sources:

MDHSS HSEES Reports, the State of Missouri Emergency Management Agency (SEMA), the Federal Highway Administration, United States Department of Energy, Center for Disease Control/Agency for Toxic Substances and Disease Registry (ATSDR), Missouri Department of Natural Resources and the Missouri Environmental Emergency Response Tracking System (MEERTS), Missouri State Highway Patrol, and the Missouri Department of Transportation.

Figures and illustrations were adapted primarily from: MDHSS HSEES Reports, 2002 – 2004.

ANNEX L

MASS TRANSPORTATION ACCIDENTS

I. TYPE OF HAZARD

Mass Transportation Accident

II. DESCRIPTION OF HAZARD

For the purpose of this study, mass transportation is defined as the means, or system, that transfers large groups of individuals from one place to another. This annex addresses only transportation accidents involving people, not materials. Thus, mass transportation accidents include public airlines, railroad passenger cars, metro rail travel, tour buses, city bus lines, school buses, riverboat casinos, and other means of public transportation.

The State of Missouri serves as a transportation crossroad for the United States. Missouri, being centrally located in the nation, is a natural hub for many major airlines and other types of tourist and business travel. Many cross-country travelers use Missouri terminals to connect with transport changes. Our airways, railways, and highways are used as nonstop thoroughfares as well.

In 1993, Missouri's largest city, St. Louis, began operating a MetroLink rail transportation system. Before service began, ridership was projected at 12,000 per day. In August 1993, during the system's first month of operation, between 20,000 and 35,000 rode the MetroLink each day. In July 1994, the average weekday ridership topped 42,000 commuters. MetroLink carried nearly 9 million customers during its first year of operation. During 1997 and1998, 54.2 million residents rode public transportation, with MetroLink ridership continuing to grow, averaging 44,500 per day. During Independence Day celebrations on July 4, 1999, the MetroLink moved 160,833 passengers. Normally, the largest numbers of people are transported during the morning and evening rush hours.

Amtrak, the state's major passenger rail carrier, uses tracks that cross the entire state, from east to west. Although Amtrak has experienced a decline in passengers during this decade, it continues to carry a large number of passengers daily. The peak periods are related to holidays or special events.

Branson, Missouri, which is located close to the state's southwestern border, has become one of this state's major tourist attractions. It ranks high among the nation’s top attractions. Because Branson is a small community, tourists are more visible there than in Kansas City and St. Louis. The city has been expanding its services (number of hospital beds, fire equipment, ambulances) and is able to provide more assistance than other small communities in the state.

Tour bus travel in the state is on the increase. With Branson continuing to expand, more bus traffic can be expected. The Passenger Carrier Inspection Division of the Missouri Department of Transportation (MoDOT) has developed a comprehensive passenger carrier safety inspection program. Passenger carrier safety is a primary concern for the Division because Missouri, and especially Branson, is among the top tourist destinations in North America. Division inspectors conduct safety inspections at destinations or carrier terminals when buses do not have passengers on board.

In comparison, the threat of a terrorist attack on any mass transit system is relevant in Missouri. On July 7, 2005 there were 4 explosions in the London Underground during morning rush hour: first hit was

a commuter train in London's financial district that killed 7; second hit was a commuter train at King's Cross Station that killed 21 people; third hit was a commuter train west of King's Cross that killed 5 people; fourth hit was a double-decker tourist bus near King's Cross station. Scotland Yard determined that Islamic extremists were the suicide bombers. This attack exemplifies the hazard that exists for any mass transportation system in the world.

The Division has two classifications of passenger carriers: for-hire and private.

For-hire passenger carriers provide service to the general public and are required to register with the Division. Private carriers provide passenger service in furtherance of a commercial enterprise. Examples include, but are not limited to, hotel courtesy buses, airport passenger shuttle services, buses operated by professional musicians, and buses for civic and other groups such as scout groups where no fees are collected.

The definition of a passenger carrier varies somewhat depending on whether the operation is entirely intrastate or interstate. The Federal Highway Administration's Office of Motor Carriers defines interstate passenger carrier as any vehicle designed to transport more than eight passengers, including the driver across state boundaries. The Administration's definition includes any vehicle (not operated as a taxi or otherwise exempt) designed to transport more than six passengers, including the driver, within the state.

III. HISTORICAL STATISTICS

Commercial motor vehicles have been involved in a significant number of Missouri traffic accidents. In 2001 10.4 percent of all traffic accidents involved a commercial motor vehicle. Of fatal traffic accidents, 14.4 percent involved a commercial motor vehicle. A total of 168 persons were killed and 6,003 were injured in commercial motor vehicle-related accidents in 2001. Commercial motor vehicles are defined as trucks having six or more tires on the power unit, buses or school buses having occupant capacities of 16 or more, and vehicles displaying hazardous materials placards. In 2001, accidents involving buses and school buses resulted in six fatalities.

In Light Rail Progress, June 2003, national statistics for transit passengers and. motor vehicle occupants were reported; these are summarized in Table L-1 below. National motor vehicle fatality and passenger mile data are from the US Bureau of Transportation Statistics, May 2003. They are based on the average of 1990-2000 data (passenger-mile data for 2001 were not currently available).

Transit data are taken from the American Public Transportation Association (APTA) and the National Transit Database (NTDB) of the Federal Transit Administration (FTA), May 2003. Data for 1999-2001 were averaged (since all relevant data items were available for that period).

TABLE L-1

FATALITY RATES PER 100 MILLION PASSENGER-MILES HIGHWAY VEHICLE OCCUPANTS AND TRANSIT PASSENGERS

Highway Vehicles	0.89
Regional ("commuter") rail	0.03
Rail rapid transit	0.47
Light rail transit	0.23
Bus	0.07

IV. MEASURE OF PROBABILITY AND SEVERITY

A major accident can occur at any time, even though all safety precautions are in place. Based on the latest available information, the probability and severity of a mass transportation accident are both rated as moderate.

V. IMPACT OF THE HAZARD

A mass transportation accident, which could include those involving buses, could burden a local jurisdiction's available medical services. To minimize this problem, mutual aid agreements with adjoining jurisdictions should be developed between ambulance services and the hospitals. This type of hazard could involve hazardous materials or a fire, which would compound the impacts of the incident. Severe weather could also hamper response efforts.

VI. SYNOPSIS

The State of Missouri serves as a transportation crossroad for the United States. Branson, Missouri, which is located close to the state's southwestern border, has become a major tourist attraction. Because Branson is a small community, tourists represent a large portion of population. To meet the needs posed by the large number of tourists, the city has been expanding its services (number of hospital beds, fire equipment, ambulances, etc.) and is able to provide more assistance than other communities of its size. A mass transportation accident, which could include those involving buses, could burden a local jurisdiction's available medical services. To minimize this problem, mutual aid agreements with should be developed between ambulance services and hospitals of adjoining jurisdictions. The risk of this type of incident is moderate.

VII. MAPS OR OTHER ATTACHMENTS

For additional information, see the 2001 Missouri Traffic Safety Compendium, available from the Statistical Analysis Center of the Missouri State Highway Patrol, a division of Public Safety.

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ANNEX M

CIVIL DISORDER

I. TYPE OF HAZARD

Civil Disorder (Riots, Protests, Sit-Ins, Marches, Demonstrations)

II. DESCRIPTION OF HAZARD

Civil disorder is a term that generally refers to groups of people purposely choosing not to observe a law, regulation, or rule, usually in order to bring attention to their cause, concern, or agenda. In Missouri, state statutes define civil disorder as "any public disturbance involving acts of violence by assemblages of three or more persons, which cause an immediate danger of or results in damage or injury to the property or person of any other individual."

Civil disorders can take the form of small gatherings or large groups blocking or impeding access to a building, or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full-scale riot in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. In the 1990s, abortion clinics, for example, were targets for these disruptive-type activities.

Throughout this country's history, incidents that disrupted the public peace have figured prominently. The Constitutional guarantees allow for ample expression of protest and dissent, and in many cases collide with the Preamble's requirement of the government "to ensure domestic tranquility." Typical examples of such conflicting ideology include the protest movements for civil rights in the late 1960s, and the Vietnam War protest demonstrations in the mid-1970s. The balance between an individual's or group's legitimate expression of dissent and the right of the populace to live in domestic tranquility requires the diligent efforts of everyone to avoid such confrontations in the future.

In modern society, laws have evolved that govern the interaction of its members to peacefully resolve conflict. In the United States, a crowd itself is constitutionally protected under "the right of the people to peacefully assemble." However, assemblies that are not peaceable *are not protected*, and this is generally the dividing line between crowds and mobs. The laws that deal with disruptive conduct are generally grouped into offenses that disturb the public peace. They range from misdemeanors such as blocking sidewalks or challenging another to fight, to felonies such as looting and rioting. Missouri law makes "promoting civil disorder in the first degree" a class C felony, according to Section 574.070 of the Revised Missouri Statutes. As stated in one provision of the law, "Whoever teaches or demonstrates to any other person the use, application, or construction of any firearm, explosive, or incendiary device capable of causing injury or death to any person, knowing or intending that such firearm, explosive or incendiary device be used in furtherance of a civil disorder, is guilty of promoting civil disorder in the first degree."

A. Types of Crowds and Mobs

1. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four general categories:

   a. Casual Crowd—A casual crowd is merely a group of people who happen to be in the same place at the same time. Examples of this type include shoppers and sightseers. The likelihood of violent conduct is all but nonexistent.

   b. Cohesive Crowd—A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity such as worshiping, dancing, or watching a sporting event. Although they may have intense internal discipline (e.g. rooting for a team), they require substantial provocation to arouse to action.

   c. Expressive Crowd—An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest something.

   d. Aggressive Crowd—An aggressive crowd is comprised of individuals who have assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They tend to be impulsive and highly emotional and require only minimal stimulation to arouse them to violence. Examples of this type of crowd include demonstrations and strikers.

2. A mob can be defined as a large disorderly crowd or throng. Mobs are usually emotional, loud, tumultuous, violent, and lawless. Like crowds, mobs have different levels of commitment and can be classified into four categories:

   a. Aggressive Mob—An aggressive mob is one that attacks, riots, and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.

   b. Escape Mob—An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs have lost their capacity to reason and are generally impossible to control. They are characterized by unreasonable terror.

   c. Acquisitive Mob—An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding

property. Examples of acquisitive mobs would include the looting in South Central Los Angeles in 1992, or food riots in other countries.

d. Expressive Mob—An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent up emotions in highly charged situations. Examples of this type of mob include the June 1994 riots in Canada following the Stanley Cup professional hockey championship, European soccer riots, and those occurring after other sporting events in many countries, including the United States.

Although members of mobs have differing levels of commitment, as a group they are far more committed than members of a crowd. As such, a "mob mentality" sets in, which creates a cohesiveness and sense of purpose that is lacking in crowds. Thus, any strategy that causes individual members to contemplate their personal actions will tend to be more effective than treating an entire mob as a single entity.

III. HISTORICAL STATISTICS

A. Missouri

Fortunately, Missouri has not experienced a trend of consistent riotous behavior or disruptive civil disorder, as some other states have witnessed in the past several decades. While far from recent, Missouri's most notable incident is the famous 1954 prison riot in Jefferson City, which stands as the state's worst-case example of a full-scale riot. Other events in Missouri's early history, as well as those in the late 1960s through this decade, indicate the state is not immune to riots, protests, and social upheaval, but no event caused the destruction that occurred during the 1954 prison riot. Some brief examples of Missouri's riotous events are provided below.

1. In the spring of 1832, citizens in Jackson County began to show their hostility toward Mormon newcomers by stoning their houses. In July 1833, a public meeting to determine the Mormon question resulted in demands that no more Mormons be allowed to settle there, that Mormons already residing in the county move out immediately, and that the Mormon newspaper (the Evening and Morning Star) be suspended. When the Mormon settlers refused these demands, the citizens razed the newspaper office, threw the press in the Missouri River, and tarred and feathered two Mormons. The Mormons appealed their plight to Governor Daniel Dunking, who issued a decision denying any citizen the right to take into his own hands the redress of grievances. He recommended that the Mormons take their case to civil courts to uphold their rights. Incensed by this action, about 50 armed men attacked a Mormon settlement called Big Blue near Independence on October 31, 1833, beating several of the men and destroying 10 homes. Hostilities continued the next two nights. On November 4, a band of citizens fought about 30 Mormons at Big Blue; three citizens, including one Mormon, were killed. Feeling they were outnumbered, most of the Mormons left the county as a result. The few who remained eventually left as well due to continued threats and hostilities.

2. In 1906 on the night before Easter Sunday in Springfield, a mob of 6,000, fueled by alcohol and rumors of a white woman's rape, battered down the jailhouse

doors and carried away three black men who were then hanged in the town square. Within hours, new rumors spread that black neighborhoods were about to be destroyed. Hundreds of black people fled before the state militia arrived to restore order. In the months that followed, a grand jury indicted more than a dozen people for the hangings, and the story of the woman's attack proved to be untrue. Only one person went to trial, however, and the jury deadlocked without reaching a verdict. In her book about the incident and its aftermath, "Many Thousand Gone," Katherine Lederer notes that until 1906, Springfield had a thriving black population, but the population has never recovered.

3. On September 22, 1954, a full-scale riot broke out at the Men's State Penitentiary in Jefferson City at about 6 p.m., after an inmate released several prisoners. The inmate had obtained keys from a guard by a ruse. At 7:00 p.m., all available state highway patrolmen were directed to report to the penitentiary as quickly as possible to quell the riot. Several buildings and vehicles were burning at that time, and some 500 inmates were loose, hurling bricks, yelling, and attempting. Both chapels were ablaze, as well as several prison shops and factories. Seeing the fires, which were visible at dusk from about 20 miles away, prisoners at the Algoa reformatory and the women's prison staged separate rebellions there. Damage to state property at those facilities was minimal, but at the main prison, only cell houses and buildings equipped with sprinklers survived. By 11:30 p.m., 285 patrolmen in 202 cars were on the scene, and by midnight, some 100 St. Louis policemen carrying submachine guns had arrived by special train. They surrounded cell houses B and C—the only halls in which guards were still held hostage. Highway patrolmen and arriving National Guardsmen took positions on rooftops overlooking the quadrangle—a yard between the larger cell houses. From that vantage point, they opened fire, seriously wounding many inmates in the exchange. Shortly after 7 a.m. the next day, the last guard taken hostage was released, and the rioters, having no alternative, gave up shortly thereafter. By mid-morning, 2,000 police officers and National Guardsmen were on duty at the prison. When the riot was finally over, three inmates had been killed, and 21 wounded by gunfire. One other prisoner was murdered by stabbing and beating, and eight others were injured in fighting with each other. Five buildings were completely destroyed, and two others partially destroyed, resulting in more than $10 million in losses to state property.

4. On October 23, 1954, another riot occurred at the State Penitentiary while state troopers were still technically operating the institution. This melee was between white and black inmates, starting over food. Bricks began to fly, followed by gunfire from the troopers. Approximately 35 prisoners were wounded in that incident.

5. On the evening of March 19, 1958, at Algoa Intermediate Reformatory, east of Jefferson City, quick action by then Governor James T. Blair and a contingent of state highway patrolmen with riot guns quelled a potential inmate uprising. The governor himself and the patrolmen entered the facility amid reports of unrest following the resignation of the institution's acting superintendent. When no trouble occurred, the troopers were removed after about 2 hours.

6. On April 9, 1968, the Kansas City Police Department requested the help of the Missouri Highway Patrol in quelling rioting, bombing, and looting in the eastern part of the city in the wake of the Martin Luther King assassination. Over 200 officers reported to the staging area at District Four of the State Highway Department to receive their assignments, and began patrolling the downtown area. Officers arrested numerous persons for charges ranging from curfew violations to felonious assault. They remained on duty for 10 days until peace was restored.

7. Twice in May 1969, demonstrations at Lincoln University in Jefferson City resulted in about 200 highway patrolmen being called to the scene to combat arson, sniper fire, and vandalism on campus. The Student Union was burned during those demonstrations.

8. On February 17, 1975, at Algoa Intermediate Reformatory, a minor riot broke out, resulting in tear gas being thrown into dormitories at the institution. Three prison officials suffered minor injuries, and one inmate required stitches to close a wound. The incident resulted in about $5,000 in property damage.

9. In December 1977 and January 1978 in Southeast Missouri, farmers making up an American Agricultural Movement staged demonstrations to protest what they felt were unfair prices for their products, as maintained by government price supports. The rallies continued through April 1978, with picketing, tractorcades, and stoppage of highway traffic throughout the area, despite high winds, ice, and snow. More than 300 farm tractors were involved in at least one of these actions. On January 11th, highway patrol troopers on Interstate 55 (I-55) near Hayti arrested seven farmers and charged them with failure to obey a reasonable request, assault, and damaging state property. Four others were arrested on I-55 near Caruthersville for driving their pickup trucks slowly side by side, preventing traffic from passing. Twenty-five farmers with their tractors were involved in a fracas with 12 officers near Hayti. Two patrol cars were damaged, and one officer sustained minor injuries when shoved by an irate farmer into the path of a road grader.

10. On April 29, 1992, in Warrensburg, racial tensions mounted following the announcement of the controversial Rodney King verdict. The Johnson County Emergency Operations Center was activated for several hours as police remained on alert status for a potential serious disturbance. Military police from nearby Whitman Air Force Base were also placed on standby alert status, but no major problems occurred.

B. United States

1. Incidents of civil disorder that erupted into violence are part of American history, spanning several centuries. In March 1770, just prior to the Revolutionary War, a riot occurred when Boston citizens jeered and taunted British soldiers and began throwing things at them during a demonstration. Five people were killed when the troops fired during the incident, which became known as “The Boston Massacre.” Three years later, on December 16, 1773, a group of Boston citizens protested the British tax on tea to the colonies by throwing it overboard. The

"Boston Tea Party" was a harbinger of troubles that eventually led to the Revolutionary War.

2. On May 4, 1886, another violent event occurred in Haymarket Square in Chicago when a confrontation took place between police and strikers at the McCormick reaper works. A bomb was thrown and a gun battle erupted, during which seven police officers and four workers were killed. Many police and civilians were also injured in what became known as the "Haymarket Square Riot."

3. Controversy over civil rights and the unpopular war in Vietnam during the 1960s and 1970s resulted in one of the most turbulent periods in American history. During this same time, major riots occurred in Los Angeles in 1965; Detroit in 1967; Chicago in 1968 during the Democratic National Convention; Santa Barbara, California, in 1970; East Los Angeles, California, in 1970 and 1971; and Attica, New York, in 1971, during a major prison riot. Violent rioting once again erupted across the country on April 29, 1992, when four police officers were acquitted after being accused of beating a black suspect (Rodney King). Also in recent years, issues such as abortion, gay rights, immigration, and gun control have generated great public debate and resulted in many mass assemblies and demonstrations.

IV. MEASURE OF PROBABILITY AND SEVERITY

A. Probability

1. Across the nation, police reports reflect a fairly steady rate of theft, mugging, arson, and homicide incidents. But these criminal acts do not amount to "riots." In their article on "Understanding Riots" published in the Cato Journal (Vol. 14, No 1), David D. Haddock and Daniel D. Polsby note that a large crowd itself is not an incipient riot merely because it assembles a great many people. Haddock and Polsby explain that "starting signals" must occur for civil disorder to erupt; these starting signals include certain kinds of high profile events. In fact, incidents can become signals simply because they have been signals in the past. In Detroit, for example, Devils Night (the night before Halloween) has in recent years become a springboard for multiple, independent, and almost simultaneous acts of arson. With any conventional triggering event, such as news of an assassination or unpopular jury verdict, crowds form spontaneously in various places as word of the incident spreads, without any one person having to recruit them. But since not every crowd threatens to evolve into a riot, the authors reason that a significant number of people must expect and desire that the crowd will become riotous. In addition, "someone has to serve as a catalyst – a sort of entrepreneur to get things going." A typical action is the breaking of a window (a signal that can be heard by many who do not necessarily see it). Someone will throw the first stone, so to speak, when he calculates the risk of being apprehended has diminished to an acceptable level. This diminished risk is generally based on two variables – the size of the crowd relative to the police force and the probability that others will follow if someone leads. The authors conclude that once someone has taken a risk to get things started, the rioting will begin and spread until civil authorities muster enough force to make rioters believe they face a realistic prospect of arrest.

2. Nationwide, riots are apt to be a recurrent, if unpredictable, feature of social life. Without question, Missouri will continue to experience future episodes of marches, protests, demonstrations, and gatherings in various cities and communities that could lead to some type of disruptive civil disorder. However, based on the state's general history of civil disturbance and the various human factors noted above, the probability that such incidents will develop into full-scale riots is considered low.

3. Regarding penal institutions, much has been done in Missouri and other states to alleviate living conditions, which are underlying factors in many riots (prison overcrowding, poor treatment of inmates, lack of grievance procedures, etc.). The State has been building new prisons for several years, or expanding facilities to create more space and otherwise improve its facilities for its inmate population. As of September 15, 2005, 31,185 inmates were housed in the 20 state correctional centers. A map of the correctional institutions and probation and parole offices in the state is provided as Figure M-1. One federal prison is located in the state, in Springfield.

B. Severity

Should Missouri experience future incidents of disruptive civil disorder or rioting, the severity of a given event could range from low to high, depending on many factors. A spirited demonstration that gets out of hand may result in several arrests, minor damage to property (police vehicles with broken windows, etc.), some injuries, and manpower/overtime costs for police, fire, and other response services. To a greater extent, the threat of urban or intercity riots has the potential for millions of dollars in property damage, possible loss of life and serious injuries, and extensive arrests. Sustaining police at the scene for extended periods, and possibly mobilizing state highway patrol and National Guard units, can add to the extensive manpower costs. Still, such riots tend to be confined to a single site or general area of a community rather than multiple locations or several areas of the state at the same time. Once a riot has occurred, police in other cities are generally on standby for possible riotous conditions and are better able to alleviate potential disturbances before they develop into full-scale riot events.

V. IMPACT OF THE HAZARD

When rioting does break out, it generally proves extremely difficult for first-responder law enforcement authorities to quell the mob promptly. The rules of Constitutional law set stringent limits on how police officers can behave toward those whom they try to arrest. Restraint also plays a crucial part in avoiding any action that "fans the flames." Initial police presence is often undermined because forces may be staffed below the peak loads needed to bring things back under control. At a result, the riot may continue until enough state police or National Guard units arrive to bolster the arrest process and subsequently restore order. In many cases, damage to lives and property may already be extensive.

VI. SYNOPSIS

In the wake of numerous urban riots in the late 1960s and beyond, a unique approach in law enforcement began to emerge as a viable means to reduce the risk of such future riots. Known as "Community Policing," its philosophy rests on the belief that reducing and controlling serious crime requires the police

to pay renewed attention to all problems that allow serious crime to occur. In its comprehensive report following the devastating 1967 Detroit riot for example, the Kerner Commission noted that police "cannot, and should not, resist becoming involved in community service matters." The benefits to law enforcement and public order, the Commission says, include the following:

A. Because of their "front-line position" in dealing with ghetto problems, police will be better able to identify problems in their community that may lead to disorder.

B. They will be better able to handle incidents requiring police intervention.

C. Willing performance of such work can gain police the respect and support of the community.

D. Development of non-adversary contacts can provide the police with a vital source of information and intelligence concerning the communities they serve.

E. In his paper entitled "Preventing Civil Disturbances: A Community Policing Approach," Michigan State University professor Robert C. Trojanowicz says Community Policing can reduce the potential for riots beyond simply reducing racial tensions between the police and the black community. The organizational strategy of community policing, he writes, "requires freeing some police officers from the isolation of the patrol car, so they can work directly in the community and enlist them as partners in the process of policing themselves. It addresses the need that everyone in the U.S. deserves to live in a safe and stable community, free of drugs and violence, and reminds us that "until we are all safe, no one is safe." Four basic ways community policing can help in riot prevention, the author says, are as follows:

    1. It provides a means of gathering superior intelligence that allows us to identify areas at risk, the level of threat in those areas, and weaknesses and strengths within the community.

    2. It provides the police with a way to address those weaknesses, which often include crime, violence, drugs, fear of crime, disorder, neighborhood decay, and juveniles at risk.

    3. It reaches out to law-abiding people in the community and involves them in the police process, serving as the vital link required to enlist their help in actively promoting order and stability.

    4. It reduces the overall risk to riots by improving the relations between the police and the black community.

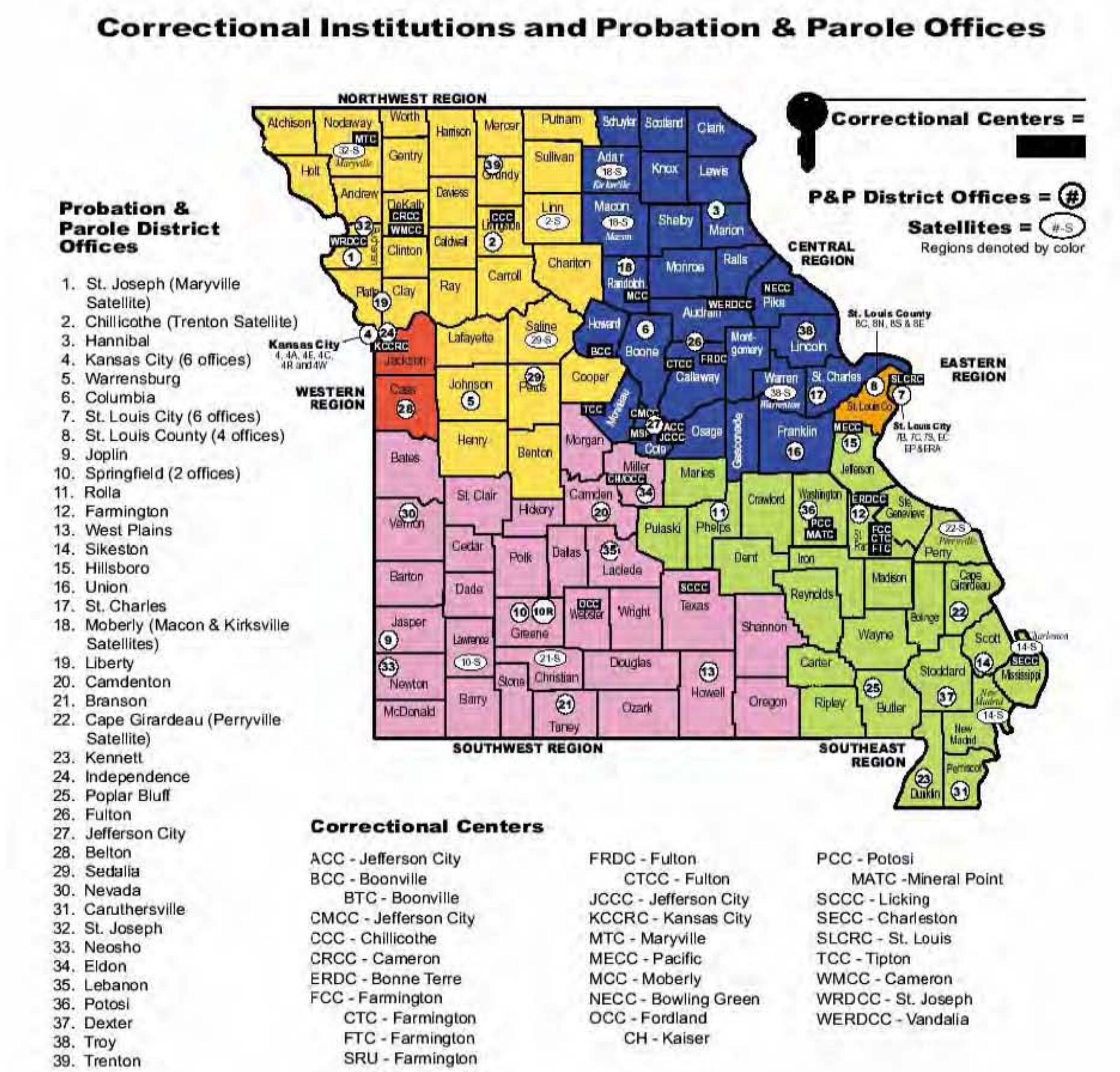
F. A community policing officer (CPO), the author notes, is a full-fledged law enforcement officer who makes arrests, but is further challenged to find new ways to address old problems. CPOs act as community advocates for needed neighborhood services (prompt trash pickup, demolition of abandoned buildings, etc.) and serve as community liaison to public and private agencies, Trojanowicz writes. "This can mean linking troubled families to affordable counseling services, linking the homeless to shelter, or tapping local business to provide donated supplies for projects to beautify the area." The

initiatives are bounded only by the collective imagination of the CPO and the people in the community and their local needs, the author concludes.

VII. MAPS OR OTHER ATTACHMENTS

A map identifying Correctional Institutions and Probation & Parole Offices is attached as Figure M-1.

FIGURE M-1


Correctional Institutions and Probation & Parole Offices
NORTHWEST REGION
CENTRAL REGION
EASTERN REGION
WESTERN REGION
SOUTHWEST REGION
SOUTHEAST REGION
Correctional Centers =
P&P District Offices = #
Satellites = #-S
Regions denoted by color
Probation & Parole District Offices
1. St. Joseph (Maryville Satellite)
2. Chillicothe (Trenton Satellite)
3. Hannibal
4. Kansas City (6 offices)
5. Warrensburg
6. Columbia
7. St. Louis City (6 offices)
8. St. Louis County (4 offices)
9. Joplin
10. Springfield (2 offices)
11. Rolla
12. Farmington
13. West Plains
14. Sikeston
15. Hillsboro
16. Union
17. St. Charles
18. Moberly (Macon & Kirksville Satellites)
19. Liberty
20. Camdenton
21. Branson
22. Cape Girardeau (Perryville Satellite)
23. Kennett
24. Independence
25. Poplar Bluff
26. Fulton
27. Jefferson City
28. Belton
29. Sedalia
30. Nevada
31. Caruthersville
32. St. Joseph
33. Neosho
34. Eldon
35. Lebanon
36. Potosi
37. Dexter
38. Troy
39. Trenton
Correctional Centers
ACC - Jefferson City
BCC - Boonville
BTC - Boonville
CMCC - Jefferson City
CCC - Chillicothe
CRCC - Cameron
ERDC - Bonne Terre
FCC - Farmington
CTC - Farmington
FTC - Farmington
SRU - Farmington
FRDC - Fulton
CTCC - Fulton
JCCC - Jefferson City
KCCRC - Kansas City
MTC - Maryville
MECC - Pacific
MCC - Moberly
NECC - Bowling Green
OCC - Fordland
CH - Kaiser
PCC - Potosi
MATC -Mineral Point
SCCC - Licking
SECC - Charleston
SLCRC - St. Louis
TCC - Tipton
WMCC - Cameron
WRDCC - St. Joseph
WERDCC - Vandalia

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ANNEX N

TERRORISM

I. TYPE OF HAZARD

Terrorism

II. DESCRIPTION OF HAZARD

Terrorism, as defined by the Federal Bureau of Investigation (FBI), is: “the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.” The effects of terrorism can vary significantly, including loss of life, injuries to people and properties, and disruptions in services (e.g., water supplies, public transportation, and communications).

According to the FBI, there are two primary types of terrorism:

1. Domestic Terrorism—involves groups or individuals whose terrorist activities are directed at elements of our government or populations without foreign direction.

2. International Terrorism—involves terrorist activity committed by groups or individuals who are foreign-based and/or directed by countries or groups outside the United States or whose activities transcend national boundaries.

A. Forms of Terrorism

Terrorism can take place in various forms, depending on the technological means available to the terrorist group, the nature of the issue motivating the attack, and the points of weakness of their target. Potential terrorist actions include:

1. Bombings—Bombings have long been used in terrorist attacks, and probably represent the most “traditional” form of terrorism. These types of incidents range from small-scale letter bombs to large-scale attacks on specific buildings. Other bomb-related incidents frequently involve “suicide bombers,” who sacrifice themselves for their cause.

2. Airline Attacks—In the past, terrorist acts involving aircrafts were generally restricted to hijackings and bombings. However, the attacks on the World Trade Center buildings in New York City in 2001 brought a new avenue to light – the use of commercial aircrafts to attack infrastructure targets. Surface-to-air missile attacks also present a threat to U.S. aircrafts.

3. Weapons of Mass Destruction (WMD) Attacks—WMD attacks usually involve nuclear weapons or biological or chemical agents. Chemical and biological agents are infectious microbes or toxins used to produce illness or death. They can be dispersed as aerosols or airborne particles directly onto a population, producing an immediate effect (a few seconds to a few minutes) or a delayed

effect (several hours to several days). Severity of injuries depends on the type and amount of the agent used and duration of exposure. Because some biological agents take time to grow and cause disease, an attack using this type of agent may go unnoticed for several days.

4. Infrastructure Attacks—These types of attacks can impact various potential targets, including water distribution systems and treatment plants, utility companies and services, emergency services, gas and oil production facilities, telecommunications centers, transportation terminals, media facilities, government buildings, and religious institutions.

5. Cyberterrorism—Cyberterrorism pertains to attacks on computer-based systems that are designed to spread disinformation and propaganda, deny service to legitimate computer users, spread electronic viruses to corrupt vital data, or cause critical infrastructure outages. Political conflicts that have led to attacks on cyber systems include clashes between India and Pakistan, Israel and the Palestinians, the North Atlantic Treaty Organization (NATO), and Serbia in Kosovo.

6. Agroterrorism—Agroterrorism involves intentional contamination of commercial produce or meat supplies. Because the U.S. supplies approximately 16 percent of the world's meat, 40 percent of its soybeans, and 41 percent of its corn, a deadly fungus or bacteria could be devastating. Of the 222 possible bioterrorism attacks that have occurred worldwide in the 20th century, only 17 of those targeted commercial livestock or plants, according to the Institute for National Strategic Studies.

7. Arson—Intentional fires have caused extensive damage during terrorist-related incidents in the past. These types of incidents may also be associated with bombings and usually target specific structures, such as churches. Although deliberately set fires have been reported at 15 churches in Missouri, none have been determined to be hatecrime-related or terrorist-related incidents.

8. Kidnappings/Assassinations—Kidnappings and assassinations may also be terrorist-related incidents, but because these events generally involve few individuals, their effect on emergency management operations may be minimal in terms of response.

B. Domestic Terrorism

According to the FBI, domestic terrorist groups represent interests that span the full spectrum of political and economic viewpoints, as well as social issues and concerns. The current domestic terrorist threat primarily comes from the following groups, white supremacists, black separatists, animal rights / environmental terrorists, anarchists, anti-abortion extremists, and self-styled militia.

1. White Supremacists or Right-Wing Terrorism—Right-wing terrorist groups often adhere to the principles of racial supremacy and embrace antigovernment, antiregulatory beliefs. Generally, extremist right-wing groups engage in activities that are protected by constitutional guarantees of free speech and

assembly. Examples of this type of group include Aryan Nations, the Order, and Posse Comitatus. Missouri has seen some activity from these groups in the past few years. According to the Southern Poverty Law Center, Missouri has 2 extremist groups operating within its borders. Although a state statute against paramilitary training exists, one of these groups is also known to have such a facility in Missouri. In addition, several special gatherings of extremist groups have taken place within the state in recent years.

2. Black Separatists – US based black separatist groups follow radical variants of Islam, and in some cases express solidarity with al-Qa'ida and other international terrorist groups.

3. Animal rights and Environmental Terrorists – Operating under the umbrella of the Animal Liberation Front and Earth Liberation Front utilize a variety of tactics against their targets, including arson, sabotage / vandalism, theft of research animals, and the occasional use of explosive devises

4. Anarchists – The potential for violence by anarchists and other emerging revolutionary groups, such as the Anarchist Black Cross Federation (ABCF), will continue to be an issue for law enforcement. The stated goals of the ABCF are "the abolishment of prisons, the system of laws, and the Capitalist state." The ABCF believes in armed resistance to achieve a stateless and classless society. ABCF has continued to organize, recruit, and train anarchists in the use of firearms.

5. Anti-abortion Extremists – The FBI is investigated anti-abortion groups. Potential violent anti-abortion extremists linked to terrorism ideologies or groups pose a current threat. The admirations of violent high-profile offenders by these extremists continue the concerns of potential anti-abortion threat activity.

C. International Terrorism

The United States continues to face a formidable challenge from international terrorism. In general terms, the international terrorist threat can be divided into three categories: loosely affiliated extremists operating under the radical jihad movement, formal terrorist organizations, and state sponsors of terrorism. Each of these categories, which represent threats to U.S. citizens and interests both abroad and at home, are described as follows:

1. Loosely Affiliated Extremists—These are motivated by political or religious beliefs, posing the most urgent threat to the United States.

2. Formal Terrorist Organizations—These organizations are typically autonomous and have their own infrastructures, personnel, financial arrangements, and training facilities.

3. State Sponsors of Terrorism—This category is comprised of countries known to sponsor terrorism and to view it as a tool of foreign policy. Currently, the U.S.

Department of State recognizes seven countries in this category: Iran, Iraq, Sudan, Libya, Syria, Cuba, and North Korea.

Table N-1 summarizes foreign terrorist organizations designated by the U.S. Secretary of State. Other international terrorist groups documented as being active in 2000 are listed in Table N-2.

TABLE N-1

FOREIGN TERRORIST ORGANIZATIONS*

Group Name	Location/Area of Operation
Abu Nidal Organization (ANO)	Iraq, Lebanon, Libya, Egypt
Abu Sayyaf Group (ASG)	Philippines, Malaysia
Armed Islamic Group (GIA)	Algeria
Akum Supreme Truth (Aum)	Japan, Russia
Basque Fatherland and Liberty (ETA)	Spain, France
Al-Gama'a al-Islamiyya (Islamic Group IG)	Egypt, Sudan, United Kingdom, Afghanistan, Austria, Yemen
HAMAS (Islamic Resistance Movement)	Israel
Harakat ul-Mujahidin (HUM)	Pakistan, Afghanistan
Hizballah (Party of God)	Lebanon; also cells in Europe, South America, North America, and Asia
Islamic Movement of Uzbekistan (IMU)	Afghanistan, Tajikistan, Uzbekistan, Kyrgyzstan
Japanese Red Army (JRA)	Unknown; possibly Asia or Lebanon
Al-Jihad	Egypt, Afghanistan, Pakistan, Sudan, Lebanon, United Kingdom
Kach and Kahane Chai	Israel, West Bank settlements
Kurdistan Workers' Party (PKK)	Turkey, Europe, Middle East
Liberation Tigers of Tamil Eelam (LTTE)	Sri Lanka
Mujahedin-e Khalq Oranization (MEK or MKO)	Iran, Iraq
National Liberation Army (ELN)-Columbia	Columbia, Venezuela
The Palestine Islamic Jihad (PIJ)	Israel, Jordan, Lebanon, Syria
Palestine Liberation Front (PLF)	Iraq
Popular Front for the Liberation of Palestine (PFLP)	Syria, Lebanon, Israel
Popular Front for the Liberation of Palestine-General Command (PFLP-GC)	Damascus, Lebanon
Al-Quida	Afghanistan
Revolutionary Armed Forces of Columbia (FARC)	Columbia, Venezuela, Panama, Ecuador
Revolutionary Organization 17 November (17 November)	Unknown
Revolutionary People's Liberation Party/Front (DHKP/C)	Turkey
Revolutionary People's Struggle (ELA)	Greece
Sendero Luminoso (Shining Path, or SL)	Peru
Tupac Amaru Revolutionary Movement (MRTA)	Peru

Notes:

* Designated by the U.S. Secretary of State, pursuant to Section 219 of the Immigration and Nationality Act, as amended by the Antiterrorism and Effective Death Penalty Act of 1996.

TABLE N-2

OTHER TERRORIST GROUPS
(Active in 2000)

Group Name	Location/Area of Operation
Alex Boncayao Brigade (ABB)	Philippines
Army for the Liberation of Rwanda (ALIR)	Congo, Rwanda, Burundi
Continuity Irish Republican Army (CIRA)	Northern Ireland, Irish Republic
First of October Abtifascist Resistance Group (GRAPO)	Spain
Irish Republican Army (IRA)	Northern Ireland, Irish Republic, Great Britain, Europe
Jaish-e-Mohammed (JEM) (Army of Mohammed)	Pakistan, Afghanistan
Lashkar-e-Tayyiba (LT) (Army of the Righteous)	Pakistan, Afghanistan
Loyalist Volunteer Force (LVF)	Northern Ireland, Ireland
New People's Army (NPA)	Philippines
Orange Volunteers (OV)	Northern Ireland
People Against Gangsterism and Drugs (PAGAD)	South Africa
Real IRA (RIRA)	Northern Ireland, Irish Republic, Great Britain
Red Hand Defenders (RHD)	Northern Ireland
Revolutionary United Front (RUF)	Sierra Leone, Liberia, Guinea
United Self-Defense Forces/Group of Columbia (AUC-Autodefensas Unidas de Columbia)	Columbia

D. Government Authority

After the attacks on September 11, 2001, parts of 22 domestic agencies were consolidated into one department, the Department of Homeland Security (DHS), to protect the nation against future terrorist threats. Roles of those agencies include analyzing threats and intelligence, guarding national borders and airports, protecting critical infrastructure, and coordinating response efforts for future emergencies. Many feel the creation of DHS is the most significant transformation of the U.S. government in the last 50 years. The agencies that comprise DHS are segregated into four major categories: Border and Transportation Security, Emergency Preparedness and Response, Science and Technology, and Information Analysis Infrastructure Protection. Those agencies that comprise DHS are listed in Table N-3. In addition to the agencies listed in the table, the Secret Service and the Coast Guard are also included in the Department of Homeland Security, reporting directly to the Secretary.

TABLE N-3

DHS ORGANIZATION

BORDER AND TRANSPORTATION SECURITY
U.S. Customs Service
Immigration and Naturalization Service
Federal Protective Service
Transportation Security Administration
Federal Law Enforcement Training Center
Animal and Plant Health Inspection Service
EMERGENCY PREPAREDNESS AND RESPONSE
Federal Emergency Management Agency
Strategic National Stockpile and the National Disaster Medical System
Nuclear Incident Response Team
Domestic Emergency Support Teams
National Domestic Preparedness Office
SCIENCE AND TECHNOLOGY
CBRN Countermeasures Programs
Environmental Measurements Laboratory
National BW Defense Analysis Center
Plum Island Animal Disease Center
INFORMATION ANALYSIS AND INFRASTRUCTURE PROTECTION
Critical Infrastructure Assurance Office
Federal Computer Incident Response Center
National Communications System
National Infrastructure Protection Center
Energy Security and Assurance Program

The FBI is the lead federal agency for investigating terrorism. The FBI is authorized to open an investigation whenever “facts or circumstances reasonably indicate that two or more persons are engaged in an enterprise for the purpose of furthering political or social goals wholly or in part through activities that involve force or violence and a violation of the criminal laws of the United States.” In any given year, the FBI engages in approximately 24 full-scale domestic terrorism investigations. The FBI maintains a state-of-the-art computer database known as the Terrorist Information System, which contains information on known or suspected terrorist groups and individuals. The system contains information on over 200,000 individuals and over 3,000 organizations. An essential weapon in the battle against terrorists is the Joint Terrorism Task Force (JTTF). A national JTTF, located at FBI Headquarters, includes representatives from the Department of Defense, Department of Energy, Federal Emergency Management Agency, Central Intelligence Agency, Customs Service, Secret Service and the Immigration and Naturalization Service. Additionally, there are 66 local Joint Terrorism Task Forces where representatives from federal agencies, state and local law enforcement personnel, and first responders work together to track down terrorists and prevent acts of terrorism in the US. Two Joint Terrorism Task Forces are located in Missouri, one each in Kansas City and St. Louis.

After terrorist-related events, communities may receive assistance from state and federal agencies operating within the existing Integrated Emergency Management System. The Federal Emergency Management Agency (FEMA) is the lead federal agency for supporting state and local response to the consequences of terrorist attacks.

III. HISTORICAL STATISTICS

The following section highlights noteworthy terrorist-related threats and actual attacks that have occurred in the United States since 1970.

In 1972, members of a U.S. fascist group called Order of the Rising Sun were found in possession of 30 to 40 kilograms of typhoid bacteria cultures, which they planned to use to contaminate water supplies in Chicago, St. Louis, and other large midwestern cities.

In 1984, two members of an Oregon cult headed by Bhagwan Shree Rajneesh cultivated Salmonella bacteria and used it to contaminate restaurant salad bars in an attempt to affect the outcome of a local election. Although approximately 751 people became ill and 45 were hospitalized, there were no fatalities.

In February 1993, an improvised bomb exploded in a rental van parked on the second level of the World Trade Center's parking basement. The bomb contained approximately 1,200 to 1,500 pounds of a homemade fertilizer-based explosive, urea nitrate. The blast produced a crater 150 feet in diameter and five floors deep. Although the motive for the attack was never confirmed, it is generally believed that the suspect who masterminded the bombing was either backed by a "loose network" of militant Muslims or directed by Iraq. He was arrested and sentenced to 240 years in prison. The incident, which killed six people and injured more than 1,000, was the most significant international terrorist act that had ever been committed on U.S. soil at that time.

In April 1995, a massive bomb exploded inside a rental truck parked near the Murrah Federal Building in Oklahoma City, destroying half the nine-story building and killing 168 people. The incident was traced to Timothy McVeigh, who was convicted of the bombing and later executed by lethal injection in June 2001. He was the first federal prisoner to be executed in 38 years. McVeigh was a survivalist who believed individual rights were being deprived by government agencies (e.g. gun control). Consequently, he was convinced he acted to defend the Constitution and saw himself as a crusader and hero. This was the worst terrorist event, either domestic or international in origin, that had ever occurred in the U.S. at that time.

In March 1995, four members of the Minnesota Patriots Council, a right-wing militia organization advocating the violent overthrow of the U.S. government, were convicted of conspiracy charges under the Biological Weapons Anti-terrorism Act of 1989 for planning to use ricin, a lethal biological toxin. The four men allegedly conspired to assassinate federal agents who served papers on one of them for tax violations.

In May 1995, a member of the neo-Nazi organization Aryan Nations was arrested in Ohio on charges of mail fraud. He allegedly misrepresented himself when ordering three vials of freeze-dried Yersinia Pestis, the bacteria that causes bubonic plague, from a Maryland biological laboratory.

In October 1995, the Amtrak Sunset Limited passenger train derailed near Hyder, Arizona. It was determined that the train track had been sabotaged, causing the train to derail and topple 30 feet from a bridge. A letter signed by the Sons of Gestapo was left at the scene. One person was killed and 83 others were injured in this incident.

In November 1995, members of the Tri-States Militia (a group composed of militia from at least 30 states) were arrested after being linked to five would-be terrorists whose bomb plots were thwarted by federal and state law enforcement agencies. The plots involved blowing up the Southern Poverty Law Center, offices of the Anti-Defamation League, federal buildings, abortion clinics, and gay community locations.

In December 1995, an Arkansas man was charged with possession of ricin in violation of the Biological Weapons Anti-terrorism Act. The man was arrested and subsequently hanged himself in his jail cell the next day.

In July 1996, a pipe bomb exploded in Atlanta's Centennial Olympic Park as the city was hosting the summer Olympic Games. One person was killed and dozens were wounded. It was later determined that the bomb had been planted by Eric Robert Rudolph, who was also suspected of being responsible for a double bombing at the Sandy Springs Professional Building in Atlanta in January 1997 and a double bombing at The Otherside Lounge in Atlanta in February 1997. Rudolph was arrested in May 2003 after 5 years on the run. He is a former soldier and survivalist with extreme right-wing views and is also reported to have ties to white supremacist groups.

At about 8:45 a.m. on September 11, 2001, a hijacked commercial airliner struck the North Tower of the World Trade Center in New York City. Shortly after 9:00 a.m., another hijacked aircraft crashed into the South Tower. Approximately 3,000 people were killed in the incident, and about 7,000 more were injured. Emergency responders entered the towers to assist with evacuation of the occupants and perform search and rescue and fire-suppression activities. The towers then collapsed, killing hundreds of responders, including top leaders of the Fire Department of New York City (FDNY) who had been in charge at the scene. A total of 450 responders were killed, including 23 from the New York City Police Department, 343 from FDNY, and 74 from the Port Authority of New York and New Jersey. Approximately 320 emergency responders were treated for injuries or illnesses at five nearby hospitals; others were treated at temporary triage stations. Responders and backup supplies were dispatched from all over the country, including 20 FEMA Urban Search and Rescue (USAR) task forces.

A second attack also occurred on September 11, 2001, when a hijacked airliner crashed into the western side of the Pentagon building in Washington, D.C., killing 125 people on the ground, as well as 64 people on the plane. Area hospitals treated 88 injured people. The crash damaged or destroyed three of the five interior concentric "rings" of the Pentagon building. The section where the plane hit had been recently renovated, and many offices were empty or were being used for storage at the time. Local responders arrived immediately, and other agencies, including five USAR teams, came to assist. The Arlington County Fire Department set up an incident command system and coordinated the emergency response. The rescue and recovery phase lasted 11 days, after which Arlington County transferred responsibility for the incident and site management to the FBI, on September 21, 2001. No responders were killed.

Between early October and early December 2001, five people died from anthrax infection, and at least 13 others contracted the disease in Washington, D.C.; New York City; Trenton, New Jersey; and Boca Raton, Florida. Anthrax spores were found in a number of government buildings and postal facilities in these and other areas. Most of the confirmed anthrax cases were tied to contaminated letters mailed to media personalities and U.S. Senators. Thousands of people were potentially exposed to the spores and took preventive antibiotics. Numerous mail facilities and government buildings were shut down for investigation and decontamination. In the wake of these incidents, federal, state, and local emergency response agencies across the United States responded to thousands of calls to investigate suspicious packages, unknown powders, and other suspected exposures. Almost all of these incidents turned out to involve no actual biohazard. Nevertheless, emergency responders typically treated each call as a potentially serious health and safety risk. During this tense time in Missouri, the Department of Health

and Senior Services (DHSS) issued numerous Health Alert Advisories to local officials and the public, providing guidance on how to handle anthrax or other suspicious letters and packages during a time of extremely heightened tensions. DHSS also instituted a surveillance system, contacting health providers to obtain public health information twice weekly, while also working to improve the public health infrastructure, information sharing, health communication networks, and hospital surge capabilities.

IV. MEASURE OF PROBABILITY AND SEVERITY

A. Probability

The threat of terrorism in the United States remains a concern. Over the past few years, the level of acts committed in the U.S. has increased steadily. According to the FBI, 2 known or suspected terrorist acts were recorded in the U.S. in 1995, 3 in 1996, 4 in 1997, 5 in 1998, and 12 in 1999. In addition to the 12 acts in 1999, an additional 7 planned acts of terrorism were prevented in the U.S.

Although several different extremist groups have been identified in Missouri, there have been no indications of any specific recent terrorist activities. The potential does remain, however, for new extremist and/or terrorist groups to move into the state at any time.

An open society such as ours, which depends on technology for its continued smooth operation, remains a potential target for terrorists. Large cities with a variety of news media outlets probably represent the most likely locations for terrorist acts because terrorists generally want their acts to reverberate in the news media and reach the largest audience possible. Since Missouri does not have large media markets compared to some states, it is not as likely a target for terrorist activity as those other states. However, the Oklahoma City bombing debunked the idea that rural America is completely safe from terrorists.

With this in mind, it appears that a terrorist attack could occur in Missouri, but the probability of such an attack is low.

HOMELAND SECURITY ADVISORY SYSTEM

Because of the potential for future terrorist-related incidents, a national security alert system was developed to disseminate information regarding the risk of terrorist acts to federal, state, and local governments and to the American people. This system, known as the Homeland Security Advisory System (HAAS), is based on five color-coded threat conditions, which are summarized in Table N-4 below.

TABLE N-4

HOMELAND SECURITY ADVISORY SYSTEM COLOR CODES

Color	Level of Threat	Description
Red	Severe	Severe risk of terrorist attack
Orange	High	High risk of terrorist attack
Yellow	Elevated	Significant risk of terrorist attack
Blue	Guarded	General risk of terrorist attack
Green	Low	Low risk of terrorist attack

Threat conditions are assigned by the Attorney General in consultation with the Assistant to the President for Homeland Security. Threat conditions may be set for the entire nation or a particular geographic area or industrial sector. The assigned threat conditions are reviewed at regular intervals to determine whether adjustments are warranted.

Missouri's State Emergency Management Agency (SEMA) is currently developing guidelines for implementing the HAAS at the local level, with recommended actions for each threat condition. When completed, those guidelines will be available on SEMA's website.

B. Severity

Should Missouri experience a terrorist attack, the severity of such an attack could range from high to low depending on the attack. For instance, if a building was blown up and no lives were lost, the severity of the attack would be low. However, if a terrorist group decided to contaminate a large urban area's water supply with a poisonous chemical, the severity of the attack could be very high due to the number of people directly affected by the poisoned water, as well as damage to that community's sense of well-being. An attack of this nature could easily result in mass hysteria and insecurity concerning the government's ability to protect its citizens.

V. IMPACT OF THE HAZARD

As stated above, terrorist acts could easily undermine the confidence that people have in their own security and that of their government's ability to protect them from harm. For example, instructions to make bombs are readily accessible to potential terrorists (including via the Internet), and the materials for their construction are readily available. Because bombs can be made so easily, the threat of a bomb should not be taken lightly. Even the threat of a bomb can disrupt a community almost as effectively as an actual bomb, while creating far fewer risks for the persons making the threat. Therefore, no matter how large or small the incident, a terrorist act can have a major impact on a community.

VI. SYNOPSIS

The trend toward high-profile, high-impact attacks has corresponded with growing concerns over the potential use of weapons of mass destruction. Between 1997 and 2000, the FBI investigated 779 WMD-related reports, generally involving individuals or small groups. The vast majority of these cases were found to be false or fabricated reports. The biological toxin ricin and the bacterial agent anthrax are emerging as the most prevalent agents involved in those investigations. In 2000, 90 of 115 biological threats investigated by the FBI involved threatened use of anthrax. Given the potential for inflicting large-scale injury or death, the efforts of international and domestic terrorists to acquire WMD remains a significant concern and priority of the FBI.

- A terrorist can attack a society in many ways. Therefore, people must prepare for such an incident. In response to these terror threats, Missouri Governor Matt Blunt selected Mr. Mark James as Director of the Department of Public Safety. To improve and assist in the homeland security efforts, Governor Blunt signed an executive order formalizing the merger of homeland security responsibilities into the Department of Public Safety. Mr. James will chair a 17-member council made up of directors from other State of Missouri departments and agencies. These include the State Emergency Management, Department of Health and Senior Services, Department of Transportation, Department of Agriculture,

Department of Natural Resources, Department of Economic Development, Missouri State Highway Patrol, Missouri State Water Patrol, Missouri National Guard, Missouri State Fire Marshall, Missouri State Public Service Commission, Chief Information Officer of the State and three members appointed by the Governor. This council will ensure that proper homeland security plans are in place at both the local and state level while also examining how homeland security grant funds can best be coordinated and expedited. The council will also prepare an emergency preparedness plan for Governor Blunt's review by January 1, 2006. This plan will include recommendations for structural changes, develop policies and procedures to implement up-to-date response capabilities. It will also recommend improvements to the homeland security grant reimbursement process.

VII. MAPS OR OTHER ATTACHMENTS

The SEMA Homeland Security Response Teams Map (Figure N-1) indicates locations of 28 existing or proposed Homeland Security Response Teams for the State of Missouri. A few of these teams include hazardous materials response teams with enhanced capabilities for response to WMD incidents, including incidents involving nuclear or radiological materials, and biological and chemical agents. The SEMA Terrorism Program should be contacted to fully determine the capabilities of the Homeland Security Response Teams in specific areas.

FIGURE N-1

Troop A -
Kansas City
Clay Co./Northland Fire
Chiefs Assoc. (NFCA)
Lee's Summit
Sedalia/Pettis Co.
Johnson County
Tri-District FPD

Troop B -
Kirksville
Hannibal

Troop C -
St. Charles/Warren Co.
St. Louis County
St. Louis City
Jefferson Co.
Franklin Co.

Troop D -
Springfield
Logan-Rogersville
Joplin
Nevada
Taney Co./Branson
City of Neosho

Troop E -
City of Jackson/SEMO HazMat Team
Ozark Regional HazMat/WMD Team
City of Kennett

Troop F -
Columbia/Boone Co.
Camden Co. HazMat Team
Cole Co. HazMat Team

Troop G -
West Plains

Troop H -
Buchanan Co./Northwest Mo. HazMat Team

Troop I -
Rolla/Phelps Co.
City of Lebanon

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ANNEX O

ATTACK
(CHEMICAL, BIOLOGICAL, RADIOLOGICAL, NUCLEAR, AND EXPLOSIVE)

I. TYPE OF HAZARD

Attack (Nuclear, Conventional, Chemical, and Biological)

II. DESCRIPTION OF HAZARD

Of all the possible disasters and hazards we can imagine, a strategic nuclear, biological, or chemical attack could be the most devastating and far-reaching in consequences. The use of these weapons against the United States in unlikely. Unfortunately, however, as long as such weapons exist, there is always a chance that they could be used. The potential for traditional war-related attacks, using conventional weapons, is a scenario that is more likely to occur, based on currently available information.

Although the threat of all-out nuclear war has been significantly reduced with the dissolution of the former Soviet Union, several scenarios still exist that might subject a jurisdiction to widespread radioactive contamination or high-levels of radiation exposure. When Phase II of the START II Treaty (passed by the U.S. Senate in 1996 and ratified by the Russian Duma in April, 2000), is complete, it will allow its signatories, Russia and the United States, to maintain only between 3,000 – 3,500 actual (versus accountable in the START) strategic nuclear weapons each, a significant reduction from Cold War numbers. Five other nations have declared their nuclear capability and another 5 are suspected of having developed nuclear weapon technology, including trouble spots, North Korea and Iran. Additionally, 15 nation states have either had weapons, or programs to develop nuclear weapons, but have reportedly abandoned their efforts. Most have now signed the nuclear non-proliferation treaty. The Department of Defense estimates that as many as 26 nations may possess chemical agents or weapons, and an additional 12 may be seeking to develop them. The Central Intelligence Agency reports that at least 10 countries are believed to be conducting research on biological agents for weaponization.

While the threat of nuclear attack has diminished over the past several years, concerns over the use of chemical and biological warfare agents have increased. Recent events, such as the September 11, 2001, terrorist attacks on the World Trade Center buildings in New York City and the Pentagon in Washington D.C., along with the anthrax-related attacks in 2001, have increased awareness of the vulnerability of the U.S. to future attacks involving chemical or biological warfare agents. For more information on terrorist-related issues, see the Terrorism annex (Annex N) of this document.

III. HISTORICAL STATISTICS

In 960-1279 A.D. arsenical smoke (a form of chemical warfare) was used in battle during China's Sung Dynasty and in 1346-1347, Mongols catapulted corpses (biological warfare) contaminated with plague over the walls into Kaffa (in Crimea), forcing besieged Genoans to flee. During World War I (1915-1918), chemical and conventional weapons were used. The first poison gas, chlorine, was used by the Germans against Allied troops in 1915. The effects of the gas were devastating, causing severe choking attacks within seconds of exposure. The British subsequently retaliated with chlorine attacks of their own, although reportedly more British suffered than the German troops, because the gas blew back into their own trenches. Phosgene was later used in the war because it caused less severe coughing, resulting

in more of the agent being inhaled. Then, in September 1917, mustard gas was used in artillery shells by the Germans against the Russians. Mustard gas caused serious blisters, both internally and externally, several hours after exposure. In all, there were 1,240,853 gas-related casualties and 91,198 deaths from gas exposure during World War I.

During World War II (1941-1945), atomic (nuclear), chemical, and conventional weapons were used. Use of chemical weapons in World War II was not as prevalent as in World War I, and was primarily limited to the Japanese Imperial Army. During the war, the Japanese used various chemical-filled munitions, including artillery shells, aerial bombs, grenades, and mortars, against Chinese military forces and civilians. Chemical agents used included phosgene, mustard, lewisite, hydrogen cyanide, and diphenyl cyanarsine. The war was brought to an abrupt end in 1945, when the U.S. dropped two atomic bombs on Japan: one on Hiroshima that obliterated the entire city and killed approximately 66,000 people, and another on Nagasaki that destroyed about half the city and killed about 39,000 people.

During the Vietnam War (1964-1973), chemical and conventional weapons were used. Chemical weapons used during the Vietnam War are believed to have only involved tear agents used by the U.S., and possibly psychedelic agents, also by the U.S. Although not directly used as warfare agents, toxic herbicides such as Agent Orange were commonly used as defoliants by the U.S. Long-term exposure to Agent Orange, which contained the contaminant dioxin, was believed to cause illness and disease in humans.

In 1983, Iraq launched its first of 10 documented chemical attacks against Iran. The largest of these attacks was in February 1986, when mustard gas and the nerve agent tabun were used, impacting up to 10,000 Iranians. Although the exact number of chemical attacks implemented by Iraq during the war is unknown, the Iranian government estimates that more than 60,000 soldiers had been exposed to mustard gas and the nerve agents sarin and tabun by the time the war ended in 1988. Based on these data, the Iraqi chemical attacks during the Iran-Iraq war were the largest since World War I.

Although several isolated attacks involving biological agents have occurred over the last few decades, the most recent series of incidents in the U.S. that gained nationwide exposure occurred between early October and early December 2001, when five people died from anthrax infection, and at least 13 others contracted the disease in Washington, D.C.; New York City; Trenton, New Jersey; and Boca Raton, Florida. Anthrax spores were found in a number of government buildings and postal facilities in these and other areas. Most of the confirmed anthrax cases were tied to contaminated letters mailed to media personalities and U.S. Senators. Thousands of people were potentially exposed to the spores and took preventive antibiotics. Numerous mail facilities and government buildings were shut down for investigation and decontamination. In the wake of these incidents, federal, state, and local emergency response agencies across the United States responded to thousands of calls to investigate suspicious packages, unknown powders, and other suspected exposures. Fortunately, almost all of these incidents turned out to involve no actual biohazard.

IV. MEASURE OF PROBABILITY AND SEVERITY

Attacks against the United States as a whole, and against individual states or local entities, can be categorized as originating from either domestic or international sources. However, because the impacts on life and property would largely be the same regardless of the source of such an attack, similar preparedness, response, and recovery activities apply.

Biological and chemical weapons have often been used to terrorize an unprotected population, instead of actual use as weapons of war. However, the potential damage that can occur in the event of such an attack is huge, particularly to human health.

A single nuclear weapon detonation could cause massive destruction, and all aforementioned types of attacks could cause extensive casualties. An all-out nuclear attack could affect the entire population in the vicinity of the impacted area. Some areas would experience direct weapons effects: blast, heat, and initial nuclear radiation. Other areas would experience indirect weapons effects, primarily radioactive fallout. As long as world leaders maintain rational thinking, the probability of an attack by a nation-state remains low, but does not rule out attack by a terrorist group.

Secondary effects of these attacks, which could severely stress the country, include lack of adequate shelter, food, water, health and medical facilities and personnel, and mortuary services, disruption of communication systems, and power outages. Because of the potential devastation and significant secondary effects caused by this type of attack, the severity is rated high.

V. IMPACT OF THE HAZARD

The population is vulnerable to two separate categories of impacts associated with these types of attacks: direct and indirect impacts. For more information on these impacts, which are often connected to terrorist-related activities, see the Terrorism annex (Annex N) of this document.

A. Direct Effects

These are effects directly associated with detonation or use of the weapon.

1. Conventional Weapons

Direct effects of conventional weapons generally are related to injuries inflicted by penetration of ammunition rounds or shrapnel from exploding ordnance (mortars, etc.). Injuries from shock waves/blast overpressure near the targets may also occur, along with damage caused by fires produced from incendiary warheads, grenades, and other munitions. In addition, some injuries may occur as a result of flying or falling debris where the weapons are used. Heavy artillery use can also damage roadways and buildings, and disrupt utility services for lengthy periods of time.

2. Chemical and Biological Weapons

Direct effects of chemical weapons involve initial spread of agents and fragmentation of the weapons. Chemical agents are toxins used to produce neurological and pulmonary injuries or death. Biological agents are infectious microbes used to produce illness or death. They can be dispersed as aerosols or airborne particles directly onto a population, producing an immediate effect (a few seconds to a few minutes for chemical agents) or a delayed effect (several hours to several days for biological agents). Severity of injuries depends on the type and amount of the agent used and duration of exposure. Because some biological agents take time to grow and cause disease, an attack using this type of agent may go unnoticed for several days.

3. Nuclear Weapons

Direct effects include intense heat, blast energy, and high-intensity nuclear radiation. These effects generally will be limited to the immediate area of the detonation (up to 22 miles), depending on weapon size, altitude of burst, and atmospheric conditions.

4. Agroterrorism

The direct effect of agroterrorism is the intentional introduction of a contagious animal disease or fast spreading plant disease that affects livestock and food crops and disrupts the food supply chain. Agroterrorism could cause disease in livestock, crops, and in some cases (anthrax, or monkey pox, for example), humans. Diseases that can be transmitted to humans from animals are called zoonotic. It would not only require the agriculture industry to destroy livestock and food crops, but also affect the consumer confidence in the food supply resulting in tremendous economic damage for, potentially, an extended period. The food supply could be severely affected not only for the immediate area and the U.S., but the world market since the U.S. exports huge quantities of food to other nations. Recently the federal government has recognized the vulnerability of the agricultural/food supply industry and potential debilitation from a terrorist incident and acted to protect the resources through Presidential Decision Directives and encouraged complementary state and local actions.

5. Radiological Weapon

Direct effects of a radiological weapon are the same as a conventional high explosive, but with the added danger posed by exposure to radiological materials. A Radiological Dispersion Device (RDD) or "dirty bomb" will contaminate an area by spreading radiological dust and debris over a large area.

6. Explosive Weapon (large amount of high explosive)

The direct results of an explosive weapon are immense destruction caused by the blast and could result in multiple fatalities. Instances of these effects include Oklahoma City, Kobhar Towers, the marine barracks in Lebanon, and the African Embassy bombings.

B. Indirect Effects

These are effects not directly associated with the detonation and use of the weapon.

1. Conventional Weapons

Unexploded ordnance throughout a battle zone or explosion hazards to those in the area can persist after warfare has ended. Many conventional munitions also contain toxic compounds that can leach into surrounding soils and groundwater if left in place.

2. Chemical and Biological Weapons

Indirect effects are generally limited to downwind areas. They can be geographically widespread and vary in intensity—depending on weapon size, type of chemical or

biological agent, and wind patterns. The spread of these agents can contaminate food and water supplies, destroy livestock, and ravage crops.

3. Nuclear Weapons

When a nuclear weapon detonates, intense heat, blast and overpressure will cause severe injuries and fatalities in the surrounding area and radiation poisoning at more distant locations. A detonation near or on the ground draws up large quantities of earth and debris into a mushroom cloud. This material becomes radioactive, and the particles can be carried by wind hundreds of miles before they drop back to earth as "fallout." In an attack, many areas of the United States would probably escape fallout altogether or experience non-life-threatening levels of radiation. However, because weather that determines where fallout will land is so unpredictable, *no* locality in the United States is free from risk of receiving deadly radiation levels after a strategic attack. Less than lethal exposures will result in longer-term effects on health and contamination of food, water, and food production.

4. Agroterrorism

Agroterrorism's indirect effects are loss of breeding stock to replenish herds and flocks; loss of seed crops; and possibly loss of land use for a long period of time depending on the disease involved. Agroterrorism has a high probability of creating an economic disaster for states highly vested in food production, and potentially the nation.

5. Radiological Weapon

The indirect effect of a RDD is inability to use the contaminated area for a short-to long-time period, depending on the identity of the radioactive material. Because radioactive material from a RDD can penetrate wood, asphalt, concrete, and masonry (and radioactive dust and particles can enter the smallest crevices), decontamination will be extremely difficult or impossible.

6. Explosive Weapon (large amount of high explosive)

The indirect effect of an explosive weapon is the fear, terror, and lasting psychological damage to survivors and other individuals.

VI. SYNOPSIS

Even though the START treaty has reduced the overall number of nuclear weapons, and many chemical/biological weapons stockpiles being destroyed, we must continue to plan for, and be prepared for, this type of hazard. In many ways, while the risk of a nuclear exchange by the "super-powers" is greatly reduced, the potential risk of proliferation of WMD is greater than during the Cold War era.

While it may not be possible to prevent such an attack, steps can be taken to lessen the likelihood or the potential effects of an incident by implementing certain measures:

- Identifying and organizing resources

- Conducting a risk or threat assessment and estimating losses
- Identifying mitigation measures that will reduce the effects of the hazards and developing strategies to deal with the mitigation measures in order of priority
- Implementing the measures and evaluating the results (and keeping the plan up-to-date).

VII. MAPS OR OTHER ATTACHMENTS

No attachments or maps are available.

VIII. BIBLIOGRAPHY

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ANNEX P

PUBLIC HEALTH EMERGENCIES; ENVIRONMENTAL ISSUES

I. TYPE OF HAZARD

Public Health Emergencies; Environmental Issues

II. DESCRIPTION OF HAZARD

Public health emergencies can take many forms—disease epidemics, large-scale incidents of food or water contamination, or extended periods without adequate water and sewer services. There can also be harmful exposure to chemical, radiological, or biological agents, and large-scale infestations of disease-carrying insects or rodents. The first part of this section focuses on emerging public health concerns and potential pandemics, while the second part addresses air and water pollution caused by natural or man-induced means.

Public health emergencies can occur as primary events by themselves, or they may be secondary to another disaster or emergency, such as tornado, flood, or hazardous material incident. For more information on those particular incidents, see Annex A (Tornadoes/Severe Thunderstorms), Annex B (Riverine Flooding), and Annex K (Hazardous Materials). The common characteristic of most public health emergencies is that they adversely impact, or have the potential to adversely impact, a large number of people. Public health emergencies can be world wide or localized in scope and magnitude.

In particular, two public health hazards have recently emerged as issues of great concern, with far reaching consequences. One pertains to the intentional release of a radiological, chemical, or biological agent, as a terrorist act of sabotage to adversely impact a large number of people. For more information on biochemical terrorism (including discussions on potential pandemics and other public health emergencies), see the Annex N of this document. The second hazard concerns a deadly outbreak (other than one caused by an act of terrorism) that could kill or sicken thousands of people across the county or around the globe, as in the case of the Spanish Flu epidemic of 1918-1919.

Whether natural or man-induced, health officials say the threat of a dangerous new strain of influenza virus in pandemic proportions is a very real possibility in the years ahead. Unlike most illnesses, the flu is especially dangerous because it is spread through the air. A classic definition of influenza is a respiratory infection with fever. Each year, flu infects humans and spreads around the globe. There are three types of influenza virus, known as Types A, B, and C. Type A is the most common, most severe, and the primary cause of flu epidemics. Type B cases occur sporadically and sometimes as regional or widespread epidemics. Type C cases are quite rare and hence sporadic, but localized outbreaks have occurred. Seasonal influenza usually is treatable, and the mortality rate remains low. Each year, scientists estimate which particular strain of flu is likely to spread, and they create a vaccine to combat it. A flu pandemic occurs when the virus suddenly changes or mutates and undergoes an “antigenic shift,” permitting it to attach to a person’s respiratory system and leave the body’s immune system defenseless against the invader.

Environmental concerns addressed in this annex focus on air and water pollution, because contamination of those media can have widespread impacts on public health, with devastating consequences. Particular issues of primary concern associated with sources of air and water pollution change over time depending on recent industrial activity, economic development, enforcement of environmental regulations, new

scientific information on adverse health affects of particular contaminants or concentrations, and other factors. Those issues are d detailed in Sections VI and VII of this annex.

III. HISTORICAL STATISTICS

A. Influenza Pandemics

Epidemic influenza, an age-old infectious disease, kills several thousand men and women in the United States every year. Since the early 1900s, three lethal pandemics have swept the globe, although none have compared to the infamous Spanish Flu event of 1918-1919, which killed more than 20 million people. The 1957 Asian Flu and the 1968 Hong Kong Flu also were killers, although they weren't nearly as virulent as the 1918 strain. The 1957 epidemic killed about 70,000 people in the United States, mostly the elderly and chronically ill. Another 34,000 Americans died from the 1968 epidemic. While both of these latter epidemics cost many lives, neither was as severe as the Spanish Flu of 1918, which claimed more than 700,000 lives in the U.S alone. Its primary victims were mostly young, healthy adults. In addition to those three pandemics, several "pandemic scares" have occurred.

1. Spanish Flu of 1918-1919

In 1918, while World War I was in its fourth year, another threat began that would rival the war itself as the greatest killer in human history. The Spanish Flu swept the world in three waves during a 2-year period, beginning in March 1918 with a relatively mild assault. The first reported case occurred at Camp Funston (Fort Riley), Kansas, where 60,000 soldiers trained to be deployed overseas. Within 4 months, the virus traversed the globe, as American soldiers brought the virus to Europe. The first wave sickened thousands of people and caused many deaths (46 died at Camp Funston), but it was considered mild compared to what was to come. The second and deadliest wave struck in the autumn of 1918 and killed millions. At Camp Funston alone, there were 14,000 cases reported and 861 deaths during the first 3 weeks of October 1918. Outbreaks caused by a new variant exploded almost simultaneously in many locations, including France, Sierra Leone, Boston, and New York City, where more than 20,000 people died that fall. The flu gained its name from Spain, which was one of the hardest hit countries. From there, the flu went through the Middle East and around the world, eventually returning to the U.S. as the troops came home during its second wave. Of the 57,000 Americans who died in World War I, 43,000 died as a result of the Spanish influenza. At one point, more than 10 percent of the American workforce was bedridden. By a conservative estimate, a fifth of the human race suffered the fever and aches of influenza in 1918-1919, leaving 20 million people dead.

In 1918, Missouri's influenza death rate was 293.83 per 100,000 people, for a total of 9,677 deaths statewide from that cause alone. That figure represents18.6 percent of Missouri's total deaths that year. While the cause of the Spanish Flu remains somewhat a mystery, the epidemic was generally traced to pigs on Midwest farms, which then spread the deadly virus to farm families. As fall crops were ready for harvest in 1918, there were no field hands to get the crops in, thereby creating an agricultural disaster as well. A third wave of the Spanish Flu, much less devastating than its predecessors, made its way through the world in early 1919 and then finally died out.

Missouri's flu death rate in 1919 dropped to less than half that of the previous year (107.21 per 100,000), and by 1921, it was reduced to 87.24 deaths per 100,000 people, state statistics show.

2. Asian Flu of 1957

In February 1957, this flu pandemic was first identified in the Far East. Unlike the Spanish Flu pandemic, the 1957 virus was quickly identified, and vaccine production began in May 1957. A number of small outbreaks occurred in the U.S. during the summer of 1957, with infection rates highest among school children, young adults, and pregnant women; however, the elderly had the highest rates of death. A second wave of infections occurred in early 1958, which is typical of many pandemics.

3. Hong Kong Flu of 1968

In early 1968, this influenza pandemic was first detected in Hong Kong. The first cases in the U.S. were detected in September 1968, although widespread illness did not occur until December. This became the mildest pandemic of the 20th century, with those over the age of 65 being the most likely to die. People with earlier infections by the Asian Flu virus may have developed some immunity against the Hong Kong Flu virus. Also, this pandemic peaked during school holidays in December, limiting student-related infections.

4. Flu Scares: Swine Flu of 1976, Russian Flu of 1977, and Avian Flu of 1997

Three notable flu scares have occurred in the 20th century. In 1976, a swine-type influenza virus appeared in a U.S. military barracks (Fort Dix, New Jersey). Scientists determined it was an antigenically drifted variant of the feared 1918 virus. Fortunately, a pandemic never materialized, although the news media made a significant argument about the need for a Swine Flu vaccine.

In May 1977, influenza viruses in northern China spread rapidly and caused epidemic disease in children and young adults. By January 1978, the virus, subsequently known as the Russian Flu, had spread around the world, including the United States. A vaccine was developed for the virus for the 1978-1979 flu season. Because illness occurred primarily in children, this was not considered a true pandemic.

In March 1997, scores of chickens in Hong Kong's rural New Territories began to die—6,800 on three farms alone. The Avian Flu virus was especially virulent, and made an unusual jump from chickens to humans. At least 18 people were infected, and six died in the outbreak. Chinese authorities acted quickly to exterminate over 1,000,000 chickens and successfully prevented further spread of the disease.

B. Other Diseases Of Public Health Concern

1. Smallpox

Smallpox is a contagious, sometimes fatal, infectious disease. There is no specific treatment for smallpox disease, and the only prevention is vaccination. Smallpox is caused by the variola virus that emerged in human populations thousands of years ago. It

is generally spread by face-to-face contact or by direct contact with infected bodily fluids or contaminated objects (such as bedding or clothing). A person with smallpox is sometimes contagious with onset of fever, but the person becomes most contagious with the onset of rash. The rash typically develops into sores that spread over all parts of the body. The infected person remains contagious until the last smallpox scab is gone. Smallpox outbreaks have occurred periodically for thousands of years, but the disease is now largely eradicated after a worldwide vaccination program was implemented. After the disease was eliminated, routine vaccination among the general public was stopped. The last case of smallpox in the United States was in 1949.

It should be noted that after recent terrorist events in the U.S., there is heightened concern that the variola virus might be used as an agent of bioterrorism. For this reason, the U.S. government is taking precautions for dealing with a smallpox outbreak. For further information on this issue, see the Terrorism section of this report (Section N).

2. St. Louis Encephalitis

In the United States, the leading type of epidemic flaviviral encephalitis is St. Louis encephalitis (SLE), which is transmitted by mosquitoes that become infected by feeding on birds infected with the virus. SLE is the most common mosquito-transmitted pathogen in the U.S. There is no evidence to suggest that the virus can be spread from person to person. Since 1964, there have been 4,437 confirmed cases of SLE, with an average of 193 cases per year. It should be noted, however, that less than 1 percent of SLE infections are clinically apparent, so the vast majority of infections remain undiagnosed. Illnesses range from mild headaches and fever to convulsions, coma, and paralysis. The last major outbreak of SLE occurred in the Midwest from 1974 to 1977, when over 2,500 cases were reported in 35 states. The disease is generally milder in children than in adults, with the elderly at highest risk for severe illness and death. Approximately 5 to 15 percent of cases are fatal; no vaccine against SLE exists.

3. Meningitis

Meningitis is an infection of fluid that surrounds a person’s spinal cord and brain. High fever, headache, and stiff neck are common symptoms of meningitis, which can develop between several hours to 1 to 2 days after exposure. Meningitis can be caused by either a viral or bacterial infection; however, a correct diagnosis is critically important, because treatments for the two varieties differ. Meningitis is transmitted through direct contact with respiratory secretions from an infected carrier. Primary risk groups include infants and young children, household contact with patients, and refugees. The disease is of most concern in Africa, where 213,658 cases were reported during 1996-1997, with 21,830 deaths. In the United States, periodic outbreaks continue to occur, particularly among adolescents and young adults. Generally, 10 to 15 percent of cases are fatal, and 10 to 15 percent of those who recover suffer from permanent hearing loss, mental retardation, loss of limbs, or other serious effects. Vaccines have been developed for some strains of meningitis, although some of those vaccines are not routinely used in the United States.

4. Lyme Disease

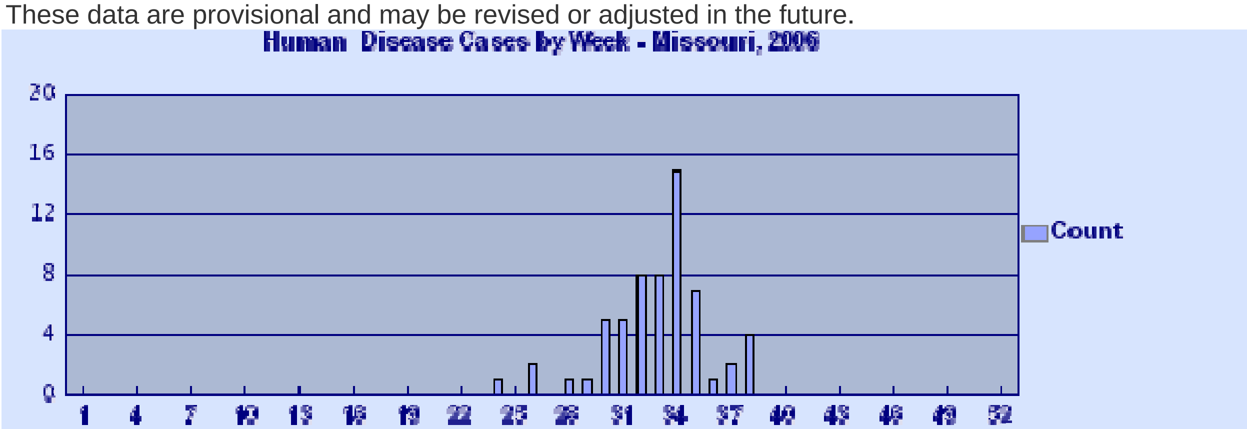
Lyme disease was named after the town of Lyme, Connecticut, where an unusually large frequency of arthritis-like symptoms was observed in children in 1977. It was later found that the problem was caused by bacteria transmitted to humans by infected deer ticks, causing more than 16,000 reported infections in the United States each year (however, the disease is greatly under-reported). Lyme disease bacteria are not transmitted from person to person. Following a tick bite, 80 percent of patients develop a red “bulls-eye” rash, accompanied by tiredness, fever, headache, stiff neck, muscle aches, and joint pain. If untreated, some patients may develop arthritis, neurological abnormalities, and cardiac problems, weeks to months later. Lyme disease is rarely fatal. During early stages of the disease, oral antibiotic treatment is generally effective, while intravenous treatment may be required in more severe cases. In the U.S., Lyme disease is mostly found in the northeastern, mid-Atlantic, and upper north-central regions, and in several counties in northwestern California. In 1999, 16,273 cases of Lyme disease were reported to the Centers for Disease Control and Prevention (CDC). There have been no reported cases of lyme disease that originated in Missouri.

5. West Nile Virus

West Nile virus is a flavivirus spread by infected mosquitoes and is commonly found in Africa, West Asia, and the Middle East. It was first documented in the United States in 1999. Although it is not known where the U.S. virus originated, it most closely resembles strains found in the Middle East. It is closely related to St. Louis encephalitis and can infect humans, birds, mosquitoes, horses, and other mammals. Most people who become infected with West Nile virus will have either no symptoms or only mild effects. However, on rare occasions, the infection can result in severe and sometimes fatal illness. There is no evidence to suggest that the virus can be spread from person to person. An abundance of dead birds in an area may indicate that West Nile virus is circulating between the birds and mosquitoes in that area. Although birds are particularly susceptible to the virus, most infected birds survive. The continued expansion of West Nile virus in the United States indicates that it is permanently established in the Western Hemisphere.

Cumulative 2006 Data as of 3 am, Oct 31, 2006

These data are provisional and may be revised or adjusted in the future.



Cumulative Human Disease Cases by County - Missouri, 2006

Audrain County	1	Laclede County	1
Barton County	1	Lawrence County	1
Boone County	4	Pike County	1
Buchanan County	2	Saint Charles County	1
Cass County	1	Saint Louis City	12
Christian County	1	Saint Louis County	13
Clay County	1	Saline County	1
Daviess County	1	Texas County	1
Franklin County	1	Webster County	1
Greene County	1	Wright County	1
Howell County	1		
Jackson County	8		
Jasper County	2		
Jefferson County	2		

6. Severe Acute Respiratory Syndrome (SARS)

Severe acute respiratory syndrome (SARS) is a respiratory illness that has recently been reported in Asia, North America, and Europe. Although the cause of SARS is currently unknown, scientists have detected in SARS patients a previously unrecognized coronavirus that appears to be a likely source of the illness. In general, humans infected with SARS exhibit fevers greater than 100.4 °F, headaches, an overall feeling of discomfort, and body aches. Some people also experience mild respiratory symptoms. After 2 to 7 days, SARS patients may develop a dry cough and have trouble breathing. The primary way that SARS appears to spread is by close person-to-person contact; particularly by an infected person coughing or sneezing contaminated droplets onto another person, with a transfer of those droplets to the victim's eyes, nose, or mouth.

C. Environmental Incidents

For information regarding historical incidents involving air and water pollution in Missouri, see Annex K of this document.

IV. MEASURE OF PROBABILITY AND SEVERITY

Health officials agree there is a high probability we will see another dangerous new strain of the influenza virus sometime in the future. In fact, a worldwide influenza outbreak on the scale and severity of the Spanish Flu is not far-fetched, and is expected by many experts. Should such a killer-virus strike today, the results in Missouri and elsewhere could be catastrophic. Today, a much larger percentage of the world's population is clustered in cities, making them ideal breeding grounds for epidemics. Additionally, the explosive growth in air travel means the virus literally could be spread around the globe within hours. Under such unique conditions, there may be very little warning time. Most experts believe we will have just 1 to 6 months between the time that a dangerous new influenza strain is identified and the time that outbreaks begin to occur in the U.S. Outbreaks are expected to occur simultaneously throughout much of the nation, preventing shifts in human and material resources that normally occur with other natural disasters. These and many other aspects make an influenza pandemic unlike any other public health emergency or community disaster.

Environmental concerns are also on the rise, with recent scientific data emphasizing the long-term impacts that air and water pollution can have on the ecology of the affected areas. With continued enforcement of regulatory standards for airborne releases and discharges to waterways, routine emissions by industrial facilities are relatively easy to monitor and control. However, the potential always remains for unauthorized dumping and releases, and for failure of systems to control industrial discharges, resulting in potential environmental emergencies.

V. IMPACT OF THE HAZARD

For planning purposes, it is reasonable to assume a rapid movement of a pandemic flu virus from major metropolitan areas to rural areas of the state. The effect of a pandemic on individual communities would likely be relatively prolonged—weeks to months. The impact of the next pandemic could have a devastating effect on the health and well being of Missouri citizens and the American public. For such an outbreak in the future, CDC estimates that in the U.S. alone:

- Up to 200 million persons will be infected.

- Between 40 and 100 million persons will become clinically ill.

- Between 18 and 45 million persons will require outpatient care.

- Between 300,000 and 800,000 persons will be hospitalized.

- Between 88,000 and 300,000 people will die nationwide.

- Effective preventive and therapeutic measures, including vaccines and antiviral agents, likely will be in short supply, as well as some antibiotics to treat secondary infections.

- Based on the CDC's preliminary estimates, economic losses from the next pandemic may range from $71 to 166 billion, depending on the attack rate.

Compared to public health emergencies, as previously described, environmental incidents involving air and water pollution would likely impact a more localized area; however, long-term affects on the environment in the impacted area could linger for many years.

VI. SYNOPSIS

A. Public Health Emergencies

The Missouri Department of Health and Senior Services (MDHSS) and the State Emergency Management Agency (SEMA) were selected by the CDC and the Council of State and Territorial Epidemiologists (CSTE) to test a national plan for dealing with a catastrophic flu outbreak. MDHSS and SEMA designed an interactive exercise, "FLUEX '98," to test two draft national response documents: (1) Influenza Pandemic Preparedness Action Plan for the United States, and (2) Pandemic Influenza: A Planning Guide for State and Local Officials. These documents were used for the design of FLUEX, and during the exercise itself. FLUEX was held February 4-5, 1998, in the State Emergency Operations Center at SEMA headquarters in Jefferson City, Missouri, and included more than 100 participants. Missouri was the only state in the nation to hold such an exercise, and one of only six states to help test the proposed national plan. Major topics explored during FLUEX included the following:

- Identifying quickly circulating viruses

- Allocating potentially scarce vaccine supplies

- Communicating emergency health information to the public

- Keeping essential public safety services operating during a time of widespread illness among employees.

As a follow-up to that planning event, the Federal Emergency Management Agency (FEMA) conducted a satellite video conference on planning for an influenza pandemic, which was broadcast nationally on February 25, 1999. SEMA, MDHSS, and local health departments hosted sites for the telecast across the state. The videoconference highlighted Missouri's planning efforts to date and featured health officials from Connecticut and Maine. They joined with a special panel at CDC headquarters in Atlanta, including SEMA's exercise officer, to answer a wide range of call-in questions on crisis management for a pandemic.

The sudden and unpredictable emergence of pandemic influenza and its potential for causing severe health, social, and economic consequences strongly requires the need for a comprehensive, action-oriented strategy. Principal goals of the national plan are two-fold: to improve prevention and control of influenza in the U.S. during the present (interpandemic) period, and to identify and implement specific ways and procedures to improve readiness for a future pandemic. As the CDC revises the draft national plan, Missouri will prepare an emergency response plan to deal with an influenza pandemic on the state level. MDHSS emphasizes that Missouri needs to prepare now to deal with challenges that could arise, such as vaccine shortages, widespread illness, and disruption in essential services. This was proven to be a pre-cursor for the bioterroism planning and exercising that was a result of the anthrax event that occurred in October 2001. Following this event the MDHSS and the LPHAs in Missouri played a significant role in all emergency/disaster preparedness.

B. Environmental Issues

Although Missouri has never had an environmental disaster of large proportions, there are many instances where hazardous substances can impact the environment with considerable consequences to either air or water. Floods often temporarily interrupt community water supplies, creating the need for emergency potable water for thousands of people. In July 1993, for example, St. Joseph's municipal water plant was forced to shut down for an extended period when contaminated floodwater threatened to enter the system. Floodwaters also disrupt wastewater treatment facilities, resulting in the discharge of raw or improperly treated sewage. Periodically, water pollutants cause fish kills in Missouri streams, and excessive air pollutants associated with smog in large metropolitan areas create public health problems.

1. Air Pollution

Air quality in Missouri is monitored at 72 stations throughout the state. These stations are maintained by the U.S. Environmental Protection Agency (EPA), and state and local authorities. These stations can be divided into three separate groups: National Air Monitoring Stations (NAMS), State and Local Air Monitoring Stations (SLAMS), and Special Purpose Monitors (SPM). These monitors measure suspended particulate, ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead. Lead is of particular interest because Missouri's lead industry produces about 90 percent of the new lead in the nation. The three large lead smelters in Missouri (near Herculaneum) have their own monitoring network operated by the company that runs the smelters. The state monitors the network to ensure proper function, and all data are forwarded to EPA. EPA maintains a list of facilities that release the most toxic chemicals each year. Missouri's five top facilities for 2000 are shown in Table P-1 in Section VII of this section. The top 10 chemicals released in the state are shown in Table P-2.

Because of high amounts of ozone, carbon dioxide, nitrogen compounds, and other vehicular pollutants in the St. Louis metropolitan area, vehicles registered in the counties of St. Louis, St. Charles, and Jefferson, as well as St. Louis City, are required to have their exhaust systems routinely checked to determine whether emissions standards are being achieved. In addition, all service stations around St. Louis are now required to have new gas nozzles that recapture gasoline vapors, thus preventing them from being released to the atmosphere. These vapors (unburned hydrocarbons) chemically react with nitrogen oxides when exposed to the sunlight and form ozone, which is the basis for

smog. For more information on Missouri's Air Pollution Control Program, contact the Missouri Department of Natural Resources.

2. Water Pollution

The Missouri Department of Natural Resources also maintains the state's water quality management plan, and has developed individual plans for each drainage basin in Missouri. Those drainage basins may be divided into the following geographic categories: Upper Mississippi River tributaries, Lower Mississippi River tributaries, Missouri River tributaries north of the Missouri River, Missouri River tributaries south of the Missouri River, White River tributaries, and Arkansas River tributaries.

There are 22,194.2 miles of classified Missouri streams (i.e., permanently flowing streams or streams that maintain permanent pools during dry weather). Of these waters, 48 percent (10,707.3 miles) meet clean water goals for all recognized uses. There are 203.2 miles that are not able to be assessed. The remaining 11,283.7 miles of water do not meet clean water goals for all recognized uses, but only 626.4 miles are considered to have serious water quality problems (i.e., to the point where at least one recognized use of the water body has been lost).

There are 293,319 acres of classified lakes in Missouri. Of that area, 69 percent (202,668 acres) meet clean water goals for all recognized uses. There are 70 acres that are not able to be assessed. The remaining 90,581 acres do not meet clean water goals for all recognized uses, with 46,810 acres considered to have serious water quality problems (i.e., to the point where at least one recognized use of the water body has been lost).

The most recent available water quality report indicates that the most important pollutant related issues in Missouri are as follows:

- Mercury levels in fish appear to be increasing over time.
- Twenty Class I and 380 Class II confined animal feeding operations in Missouri generate large amounts of manure, creating the potential for serious water problems.
- Eutrophication of large, recreationally important reservoirs appears to be increasing, possibly due to increased confined animal production in the watersheds of these lakes.
- Tailings from abandoned lead-zinc mines continue to impact waters long after mining operations have ceased.

The water quality report also identifies several other water quality concerns as follows:

- Channelization has caused aquatic habitat degradation in 17 percent of Missouri's streams, as well as promoted increased water velocities, stream bank erosion, and severity of flooding.

- Additional groundwater protection measures are needed, including a complete groundwater monitoring network and educational programs for those involved in the application of farm chemicals, transporters of hazardous materials, and the general public.

- Continued suburban development impacts streams by loss of stream channels, removal of riparian areas, and activities that result in increased storm water flows.

- Evidence indicates that fish and invertebrate communities in many Missouri streams are suffering from the degraded quality of the aquatic habitat.

For more information on Missouri's Water Pollution Control Program, contact the Missouri Department of Natural Resources at (573) 751-1300.

C. Identifying Pollution Hazard Areas

Local emergency management officials should identify pollution hazard areas so that in case of a natural disaster, recovery steps will not be delayed. Pollution of public drinking water, for example, can cause severe problems with re-entry and recovery. If alternate sources of safe drinking water can be identified, or relocation of water intakes can eliminate polluted drinking water, then recovery can be quicker, and local resources can be used to address other problems.

With the increases in motor vehicle registrations throughout the state, the levels of nitrocarbon emissions will naturally rise. Combinations of smog and carbon monoxide levels will also increase. These pollutants in sufficient quantities can have deleterious effects on the health of thousands of Missourians.

VII. MAPS AND OTHER ATTACHMENTS

http://westnilemaps.usgs.gov

http://www.cdc.gov/ncidod/dvbid/westnile/surv&control05Maps.htm

http://www.cdc.gov/ncidod/dvbid/westnile/surv&control05Maps_Viremic.htm

Environmental Issues: Attachments to this section include a map of the air monitoring stations in Missouri, (air.boomframe.jsp.htm) the list of the top ten facilities in Missouri with the greatest release of toxic chemicals (Table P-1), and the list of the top 10 chemicals reported to be released in Missouri (Table P-2).

TABLE P-1

TOP TEN FACILITIES IN MISSOURI SHOWING GREATEST RELEASES (2001)
(All figures are in pounds)

Facility	County	Air	Water	Land	Total*

Doe Run Co. Herculaneum Smelter	Jefferson	261,169	442	15,182,450	15,444,061
Buick Mine/Mill	Iron	55,729	5,495	13,518,560	13,579,784
Brushy Creek Mine/Mill	Reynolds	34,192	2,175	12,762,208	12,798,575
Fletcher Mine/Mill	Reynolds	37,408	1,770	11,661,687	11,700,865
Doe Run Co. Glover Smelter	Iron	40,114	107	9,396,570	9,436,791
Ameren Sioux Power Plant	St. Charles	2,376,500	9,470	1,557,061	3,943,031
Sweetwater Mine/Mill	Reynolds	12,138	520	3,845,748	3,858,406
Meramec Power Plant	St. Louis	2,110,525	12,186	1,580,080	3,702,791
Royal Oak Ent., Inc, Ellsinore, MO	Carter	2,714,500	0	0	2,714,500
Ford Motor Company – Kansas City	Clay	2,635,667	0	0	2,635,667

Notes:

* Total amounts do not include off-site releases (i.e., metals at wastewater treatment plants, disposal-related incidents); Missouri had no releases in 2001 through underground injection.

TABLE P-2

TOP TEN CHEMICALS REPORTED IN MISSOURI (2001)
(All figures are in pounds)

Chemical	Air	Water	Land	Total*
Zinc Compounds	469,929	15,910	31,123,423	31,609,262
Lead Compounds	415,337	3,448	27,854,543	28,273,328
Barium Compounds	160,735	104,257	6,791,576	7,056,568
Hydrochloric Acid (“acid aerosols” only)	5,874,476	0	168,005	6,042,481
Methanol	5,868,430	12,713	5	5,881,148
Copper Compounds	20,270	2,900	4,658,137	4,681,307
Aluminum (fume or dust)	15,413	255	3,280,796	3,296,464
Xylene (mixed isomers)	2,990,415	0	0	2,990,415
Hydrogen Fluoride	2,464,416	0	158,300	2,622,716
Sulfuric Acid (“acid aerosols” only)	1,748,549	5	480,255	2,228,809

Notes:

* Total amounts do not include off-site releases (i.e., metals at waste water treatment plants, disposal-related incidents).

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ANNEX Q

SPECIAL EVENTS CONSIDERATIONS

I. TYPE OF HAZARD

A. National Special Security Events (NSSE)

A number of factors are taken into consideration when designating an event as a National Special Security Event including a few outlined below:

1. Anticipated attendance by dignitaries - Events that are attended by officials of the United States Government and/or foreign dignitaries may create an independent federal interest in ensuring that the event transpires without incident and that sufficient resources are brought to bear in the event of an incident.
2. Size of the event - A large number of attendees and participants generally increases the security requirements. In addition, larger events are more likely to draw the attention of terrorists or other criminals, particularly those interested in employing weapons of mass destruction.
3. Significance of the event - Some events have historical, political and/or symbolic significance that may heighten concern about possible terrorist acts or other criminal activity.

When an event is designated a National Special Security Event, the Secret Service assumes its mandated role as the lead federal agency for the design and implementation of the operational security plan and coordinator for all Federal resources deployed to maintain the level of security needed for the designated events. The Federal Bureau of Investigation (FBI) serves as the lead agency responsible for intelligence and law enforcement operations as well as statutory Federal criminal investigations. The goal of such an operation is to prevent terrorist attacks and criminal acts.

Once an event is designated a National Special Security Event, the Secret Service employs existing partnerships with federal, state and local law enforcement and public safety officials with the goal of coordinating federal, state and local agencies to provide a safe and secure environment for the event and those in attendance.

Resources used as part of past NSSE operational security plans that could be deployed for upcoming NSSE designated events include physical infrastructure security fencing and barricades, special access accreditation badges, K-9 Teams, and other security technologies.

The Secret Service is responsible for planning, directing and executing federal security operations at designated NSSE's. The Secret Service also provides federal, state and local law enforcement partners who provide substantial, critical support to the protective mission with the necessary guidance and training regarding their role in the overall operational security plans.

The Emergency Preparedness and Response division within the Department of Homeland Security could pre-position some combination of the following assets: the Domestic Emergency Support Team (DEST), Urban Search and Rescue (USAR) teams, national Emergency Response Teams (ERT-N), the Nuclear Incident Response Team (NIRT), the Strategic National Stockpile

and Mobile Emergency Response System (MERS). The specific package will be tailored for each individual event based on coordination with other federal agencies, state and local jurisdictions, available local resources, mutual aid agreements and other event-specific requirements.

B. Special Event Homeland Security (SEHS) Levels

Managed by the Department of Homeland Security, the Interagency Special Events Working Group **(**SEWG) is the core of an interagency process that involves various agencies of the Federal government. Within the Special Events Working Group (SEWG), Federal departments and agencies provide input and recommendations concerning Special Events based on their respective authorities, responsibilities, and fields of expertise. The SEWG is co-chaired by designees from DHS Headquarters, the U.S. Secret Service, FEMA, and the FBI, and is currently composed of representatives from over 40 Federal departments and agencies that have responsibilities and/or association with Special Events security and incident management. The SEWG develops the *Prioritized List of Special Events*, recommends Special Event Homeland Security (SEHS) Levels, and is the single forum that ensures comprehensive and coordinated Federal interagency awareness of and support to designated Special Events.

The *Prioritized List of Special Events* is the single interagency resource delineating domestic events, activities, or meetings that do not rise to the level of a National Security Special Event (NSSE), but which nevertheless are significant. Using a risk-based approach to weigh vulnerabilities and consequences against threats, the SEWG develops the *Prioritized List of Special Events* from event recommendations submitted by each state, territory and the District of Columbia. The events are categorized into one of the four SEHS levels using objective criteria including but not limited to: size; threat; symbolic or political significance; duration; location; number and type of attendees; media coverage; dignitary participation; proximity of critical infrastructure; and state and local capabilities. Federal support is scaled according to the SEHS level. SEHS-IV only requires maintaining Federal situational awareness of the event while a wide variety of Federal prevention, protection, and response resources may be provided for SEHS-I events. Events that do not reach the threshold of SEHS-IV are not included on the list. Each SEHS level is defined as:

1. <u>SEHS-I</u>: An event of large magnitude and significant national and/or international importance requiring significant Federal support and situational awareness. This designation requires the appointment of a Federal Coordinator and the development of an Integrated Federal Support Plan.

2. <u>SEHS-II</u>: An event of medium magnitude and average national and/or international importance requiring Federal support and situational awareness. This designation also requires the appointment of a Federal Coordinator and the development of an Integrated Federal Support Plan.

3. <u>SEHS-III</u>: An event of low magnitude and low national and/or international importance requiring limited Federal support and situational awareness. Monitoring and Federal coordination for support are accomplished through the Homeland Security Operations Center (HSOC) and the SEWG.

4. SEHS-IV: An event that requires Federal awareness but does not warrant direct Federal support or involvement. DHS may assist state and local jurisdictions by providing training and exercise opportunities through existing and/or tailored programs. The HSOC will maintain awareness of the event.

II. DESCRIPTION OF HAZARD

Significant special events may include any type of event where large groups of people are gathered together, regardless of the cause or purpose of the event, where expanded security and other resources are required above and beyond the resources typically available to Local and/or State government. In such instances, event sponsors, in conjunction with Local and State authorities are responsible for coordinating the event and requesting assistance at the Federal level, if necessary.

Special events may be motivated by political, economic or social causes, as in the case of Inaugurals, State of the Union Addresses, and Summit Conferences, or by recreational causes, as with the Olympics and other major sporting events (Super Bowl, World Series, etc.). Special events may also include large holiday events such as the annual Fair St. Louis 4th of July Celebration, where large numbers of people crowd onto the Mississippi Riverfront in St. Louis.

The perception of inherent dangers and threats facing this country and the State of Missouri has changed significantly since the terrorist attacks of September 11, 2001. In keeping with the framework of the National Response Plan (NRP), the Missouri State Emergency Operations Plan (SEOP) should also provide a Hazard Analysis consideration section for special events as described herein. The following Historical Statistics Section details some of the potential impacts on security and medical resources that a "special event" could pose for consideration.

Anytime a large number of people are congregated in one area, an incident resulting from just about any of the hazards detailed in this Missouri Hazard Analysis could have devastating impacts. For example, consider the impact a sudden, severe hailstorm could have on the population visiting the aforementioned Fair St. Louis, which well over one million people usually attend each year. A hailstorm such as this struck the north St. Louis County area in April of 2001, causing thousands of dollars of damage to residences and vehicles. This storm produced baseball-size (and larger) hailstones, which killed many pets and nearly all the waterfowl residing at local park ponds. An incident such as this could have devastating impacts if it were to suddenly strike the fairgrounds with over 250,000 people in attendance and without shelter (not to mention the potential impact a terrorist attack incident could impose at such an event). Medical services would likely be overwhelmed with the number of injuries. .

III. HISTORICAL STATISTICS

A. Atlanta, Georgia, Centennial Olympic Park Bombing

On Saturday July 27, 1996, Georgia Bureau of Investigation (GBI) agents in Atlanta were dispatched to the Centennial Olympic Park for what seemed like a routine public disturbance call on the ninth day of the 1996 Summer Olympics. Apparently, some rowdy partygoers had been creating a scene at the event.

By the time GBI agents arrived, the partiers were gone. However, a security guard pointed out another problem: a green knapsack left unattended under a nearby bench. Because of the suspicious nature of the situation, a bomb diagnostic team was called as officers attempted to

keep people away from the area without creating a panic. They were unaware that a warning call had been made to 911 emergency dispatchers.

About 20 minutes later, as agents were assessing the situation and continuing to attempt to steer people away from the abandoned bag, it blew up with a powerful explosion. The blast killed one visitor and injured more than 100. All of the law officers at the scene were injured except for one. A Turkish cameraman also died of a heart attack while covering the explosion.

FBI said of this incident, “The fatal bombing in Atlanta was a terrorist attack aimed at thousands of innocent persons gathered at the Olympic Park.” This blast was the worst attack on an Olympic Games since 11 Israeli athletes were killed by Palestinian guerrillas at the 1972 Games in Munich, Germany.

B. St. Louis, Missouri, Papal Visit

Pope John Paul II visited St. Louis, Missouri, on January 26 and 27, 1999. This pastoral visit included 30 hours of speeches, parades, prayer services, and a papal Mass for about 104,000 people at the St. Louis America’s Center, which filled every available seat in the center, including the Edward Jones Dome and adjoining convention exhibit hall. This Mass is billed as the largest U.S. indoors gathering ever. This event was designated a National Special Security Event.

This 2-day series of events also included a welcome address by President Clinton and ceremonial farewell meeting with then Vice-President Al Gore, and was attended by many state officials including Missouri Governor Mel Carnahan. Event activities were spread throughout the St. Louis metropolitan area, from the Lambert-St. Louis International Airport to the downtown area and the grounds of the Gateway Arch on the Mississippi Riverfront.

This was undoubtedly the largest single “special event” to occur in the State of Missouri in recent years, with security concerns reaching to national and international levels. Close coordination between local, state, and federal law enforcement agencies is required to provide adequate security measures for events like this. The potential for hazards from mass transportation accidents was also elevated for this event, as one quote said, “Seemingly every school bus in the region was enlisted to transport people from suburban pickup points down into St. Louis America’s Center for the papal Mass”. Fortunately, this event was conducted without any major incidents.

C. St. Louis, Missouri, World Agricultural Forum Conference

The Hyatt Regency Hotel at Union Station in St. Louis hosted the “World Congress” meeting of the World Agricultural Forum May 18 to 20, 2003. The forum brought together agriculture industry leaders and world leaders to discuss the future of global agriculture. Mindful of Seattle, Washington’s, experience with violent protestors who disrupted the World Trade Organization (WTO) meeting there in December 1999, St. Louis police were braced for any possible problems that could arise from hundreds or even thousands of protestors descending on St. Louis for this event.

Four Seattle police officers were invited to St. Louis to talk about what happened at the 1999 WTO event, when 50,000 demonstrators overwhelmed 400 Seattle officers. Protestors smashed windows and vandalized cars as police fought back with rubber bullets and tear gas. Washington,

D.C., police were also invited to St. Louis to share their experiences with riots during protests of major global conferences in their city.

Although St. Louis police were not anticipating the same level or intensity of violence as in Seattle, they did have intelligence reports that some visitors would be in St. Louis who were involved in the Seattle protests and other demonstrations. Another conference, called Biodevastation 7, was scheduled immediately prior to the World Agricultural Forum (May 16 to 18, 2003) in St. Louis, which involved a gathering of opponents to genetic engineering. An organizer with the group had indicated that 200 to 800 people were expected to attend the Biodevastation 7 conference and that there would be 200 to 2,000 protestors at the World Agricultural Forum.

During this time period, in nearby Creve Coeur, Missouri, extra police were also on hand at the Monsanto property for the annual Creve Coeur Days. Monsanto, an agriculture industry leader, is a host of the annual celebration, which includes carnival rides and game booths on its property. Creve Coeur police coordinated a plan with St. Louis police to gather information about possible protests at this event.

A local international security-consulting firm was in charge of security for the World Agricultural Forum conference. They worked with St. Louis Police and other law enforcement agencies to prepare for possible protests at this event. Close coordination between these agencies helped to ensure that St. Louis was prepared to provide adequate security for the event and the international visitors to the city. Other than a couple of minor incidents between police and activists in the days leading up to the conference, no incidents were reported. A protest outside the conference on May 18 drew only a few hundred demonstrators, all peaceful, and only a handful of demonstrators were present during the event’s final two days.

D. Missouri, recent events considered for SEHS designation requiring significant State and Local resources

1. St. Louis, May 2004, World Agricultural Forum Regional Congress
2. St. Peters, June 2004, U.S. Olympic Diving Trials
3. Clayton, October 2004, Presidential Debate
4. St. Louis, October 2004, Major League Baseball World Series
5. St. Louis, April 2005, National Collegiate Athletic Association Division I Men's Basketball Final Four Tournament

IV. MEASURE OF PROBABILITY AND SEVERITY

A. Probability

Missouri will undoubtedly host future special events, which will require significant security and other emergency planning considerations. The overall probability that a disastrous incident from any cause would occur in conjunction with a designated special event or special security event is considered low to moderate. The probability for an incident to occur during any particular special event is really a function of the hazards previously detailed in this Missouri Hazard Analysis and

the probability of the independent occurrences of these hazards. However, “special events” will unfortunately continue to be likely targets for protests, rioting, and terrorist attacks in the U.S. Refer to the Measure of Probability and Severity discussions in the previous annexes of this document for more specific considerations**.**

B. Severity

The severity of incidents occurring in conjunction with designated special events could range from low to high, depending on many factors. The severity of these incidents will be a function of the number of people attending these events and the type and severity of the specific hazards to affect the events. Considerations of severity could range from a “hoax” bomb scare or terrorist threat where no one is physically injured and without any property damage, to a full-scale disaster affecting a large number of people gathered at one time with mass injuries and property damage by natural, accidental, or terrorist or criminal causes. Refer to the Measure of Probability and Severity discussions in the previous annexes of this document for more specific considerations.

V. IMPACT OF THE HAZARD

As with the measure of probability and severity, the potential impact of hazards occurring in association with any special event must be evaluated as a function of the specific hazard that could cause the impact on a large number of people attending any event. Refer to the Impact of the Hazard discussions in the previous annexes of this document for more hazard-specific impact considerations. Certainly the potential impact of any hazard can be multiplied several-fold when it affects a large number of people all at once.

VI. SYNOPSIS

Adapted from the National Response Plan (NRP): The perception of inherent dangers and complex threats facing this country and the potential consequences they could have on the American way of life has changed significantly since the terrorist attacks of September 11, 2001. These threats cross a broad spectrum of contingencies from acts of terrorism to natural disasters to other man-made hazards (accidental or intentional). Because all carry the potential for severe consequences, these threats must be addressed with a unified national effort. A new paradigm for incident management is required. This philosophy has been the mandate for change leading to development of the NRP.

This section is being added to the Missouri Hazard Analysis (Appendix 5 to the State Emergency Operations Plan) in keeping with the framework of the NRP. The NRP is being designed as an “all hazards/all disciplines” plan and considers hazards under the full range of possible contingencies, including:

- Natural Disasters
- Accidents
- Civil/Political Incidents
- Terrorist/Criminal Incidents
- Significant Events/Designated Special Events.

Significant special events are considered any type of event where large groups of people are gathered and expanded security and other resources are required above and beyond the resources typically available to local or state government. Special events may be motivated by political, economic, or social causes, as in

the case of Inaugurals, State of the Union Addresses, and Summit Conferences, or they may be motivated by recreational causes as with major sporting events or designated holiday events.

Regardless of the purpose or cause, special events will place a large number of people in one area at one time. Anytime people are crowded together in one place, an incident resulting from just about any of the hazards detailed in this Missouri Hazard Analysis could have compounded and devastating impacts.

In such instances, event sponsors, in conjunction with Local and State authorities, are responsible for coordinating the event and requesting assistance at the Federal level, if necessary.

Local and State authorities are responsible for:

- Coordinating requirements from the organization sponsoring an event
- Determining resource shortfalls and submitting resource requests, through the existing structures and mechanisms, to the national level for consideration.

Event sponsors are responsible for:

- Developing concepts for conducting the event
- Identifying resource requirements necessary to support the event
- Submitting resource requests to Local and State governments for consideration.

VII. MAPS OR OTHER ATTACHMENTS

None.

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